POWER

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Alibi Al

BY RUFUS T. STROHM

In almost every plant you'll find this specimen of humankind. He simply will not hear of taking any sort of blame that might besmirch his snowy fame as running engineer. It doesn't matter what goes wrong, as soon as trouble sprints along, he starts to dodge and shy. In spite of damning evidence as glaring as a white-washed fence, he pulls an alibi.

Just for example, let's suppose the pressure in a steam pipe blows a chunk of gasket out, and in a moment more enshrouds the boiler room in whitish clouds that roll and swirl about. Does Al speak up and frankly tell the flanges weren't parallel? He doesn't, you can bet! He vows to heaven he'll be cursed "if that there packin' ain't the worst" that he's been handed yet.

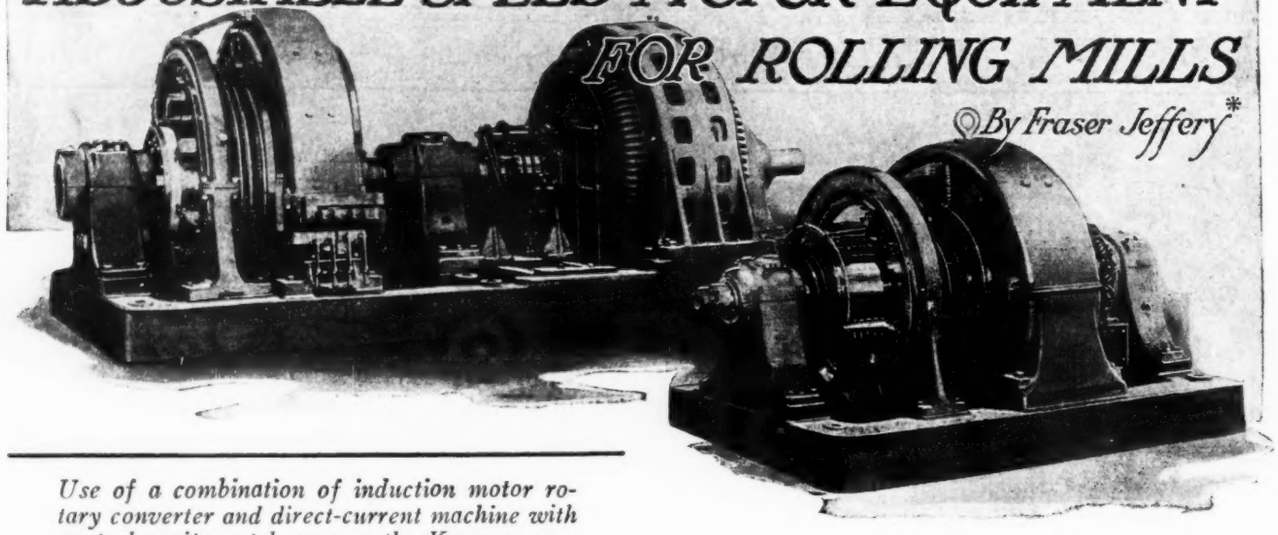
Perhaps a bearing gets so hot it scores the pin; or, like as not, turns babbitt into soup. There surely is the deuce to pay; the engine's shut down right away; the mill hands homeward troop. Yet Al disputes the honest chaps who venture to suggest, perhaps no oil was in the cup. Good heavens, no! That ain't his way! It wasn't only yesterday he filled the blamed thing up!

His boiler, in the heart of town, explodes and knocks six hen-coops down and wrecks the calaboose; but long before the echoes die, friend Al is working, swift and spry, to find a fair excuse. Suspicions of incompetence and carelessness he soon resents, or treats with loud guffaws. A boiler plate corroded thin or deeply grooved could not have been by any means the cause.

If you've a noodle packed with punk, and you believe his boastful bunk and his deceitful dope, you'll swear he's just as apt to make a conscious error or mistake as kaiser, king or pope. And so he strives with all his might to keep his record fair and white as Desdemona's cheek; but every action goes to show what all his fellow-workers know: He has a yellow streak!

ADJUSTABLE-SPEED MOTOR EQUIPMENT FOR ROLLING MILLS

By Fraser Jeffery*



Use of a combination of induction motor rotary converter and direct-current machine with control equipment known as the Kraemer system, makes it possible to obtain speeds independent of the load and economical operation at these speeds whether near synchronism or much lower.

FOR conditions necessitating a wide speed range for a given product and on a given steel mill, the ordinary slip-ring type induction motor used as the driving medium of the rolls is not suitable. The speed-torque characteristics of such a motor are such that speed control without load is not possible; in other words, to obtain a constant speed there must be a constant load. It is obvious that, in general, the rolling conditions in a steel mill are such that there is hardly ever a constant load, and at times it is highly fluctuating, varying instantly from zero to large overloads and vice versa. Assuming that the load conditions were constant and that a rolling speed such as to give a motor speed one-half of the synchronous speed was desirable, a slip-ring induction motor would prove costly from an economical operating point of view because the low speed could be obtained only by dissipating a large amount of energy in a resistance unit.

To obtain set-rolling speeds independent of the load and economical and efficient operation at these speeds, whether they are near synchronism or much lower, a combination of machines and control has been used that is well suited to the conditions to be met. A large number of these units are operating in various steel mills throughout the country today, and their application, while needing a careful analysis of all the rolling conditions to be encountered, has shown results highly satisfactory to the mill owner and operator.

A slip-ring induction motor having its primary winding connected to the source of supply and its secondary winding connected to the alternating-current side of a rotary converter and mounted on a shaft coupled to a direct-current machine, the commutator of which is permanently connected to the direct-current side of the rotary converter, forms the combination of machines as used to meet the varied speed conditions demanded. Fig. 2 shows the simplified connections of such a combination while the headpiece shows the combination of actual machines as used. In the headpiece the machine in the center background is the slip-ring induction motor direct coupled to the direct-current motor.

The rotary converter is shown in the right-hand foreground. The drive to the steel mill is by means of a coupling on the induction-motor end of the set, which is generally known as the main-mill motor, or Kraemer unit. The fields of both the direct-current machine and the rotary converter may be excited from the direct-current mill-supply line, but a separate and independent motor-generator exciter set is much to be preferred.

When voltage is applied to the primary of an induction motor, the currents in the various coils produce a magnetic field which rotates at a speed depending directly upon the frequency and inversely upon the number of poles. If the rotor is at a standstill, the secondary voltage is at maximum value and the frequency is the same as the primary frequency. The currents which flow in the secondary windings exert a torque such as

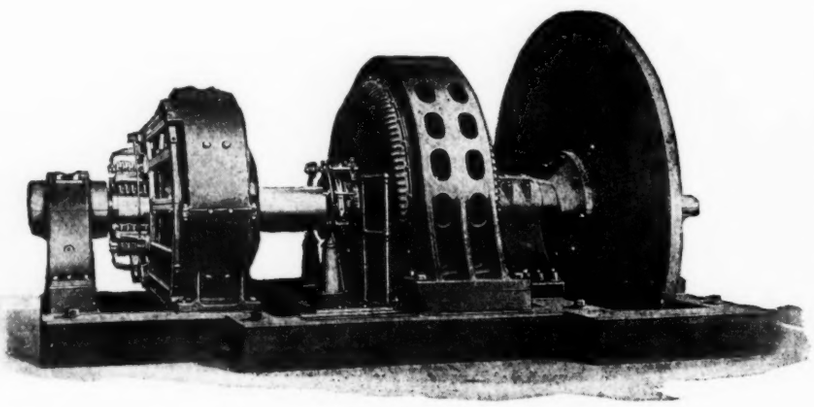


FIG. 1. FLYWHEEL ON MAIN-MOTOR SHAFT

*Electrical Engineer, Allis-Chalmers Manufacturing Company.

to cause the rotor to turn in the direction of the rotating field. As the rotor speed increases, the secondary voltage and frequency decrease until the voltage is just sufficient to send a current through the impedance of the windings to develop the torque required. At synchronism the secondary voltage and frequency are zero. If the speed is reduced (the load remaining constant) by inserting resistance in the secondary circuit, the secondary voltage and frequency are practically proportionate to the variation from the synchronous speed. If, in place of the external resistance, a means of providing a constant voltage to oppose the secondary voltage at slip frequency, is used, the speed of the rotor will adjust itself to a point where the secondary voltage will exceed the opposing voltage by an amount necessary to send a current through the impedance of the circuits, sufficient to develop the necessary torque. It is then obvious that if the opposing voltage is adjustable, the speed of the main motor readily may be changed. This is the principle of the Kraemer system for adjustable speed. The induction motor of the Kraemer unit receives its adjustable and opposing secondary voltage at slip frequency through the medium of the rotary converter.

To provide for emergencies such as a breakdown in any of the auxiliary machines, the induction motor and direct-current machine are mounted on separate shafts connected by means of a forged flange coupling. The complete unit is provided with a heavy base and three pedestal-type bearings, the center one of which, and the coupling, being so arranged that the direct-current machine may be shut down by disconnecting the coupling, thus allowing the alternating-current motor of the set to operate the mill.

A full-automatic type of magnetic control, Fig. 3, is most generally used. It is sometimes modified to include a liquid starter instead of the magnetic, and if the nature of the load is such as to impose objectionably high peak-load conditions on the line, then the use of a flywheel on the set, Fig. 1, is frequently desirable. The flywheel can be made to give up part of its energy by the proper adjustment of the field of the direct-current machine, the effect of a variation of this field being such as to slow down the direct-current machine of the Kraemer unit, thus allowing the flywheel to act and in this manner relieving the line peaks. The control may be governed through a drum-type master switch, Fig. 4, the manipulation of which starts the main-mill motor and brings it up to normal speed under current-limit acceleration; connects the rotary converter into the circuit; disconnects the starting resistance and closes the field switches of both the rotary and the direct-current machine at the proper time. For

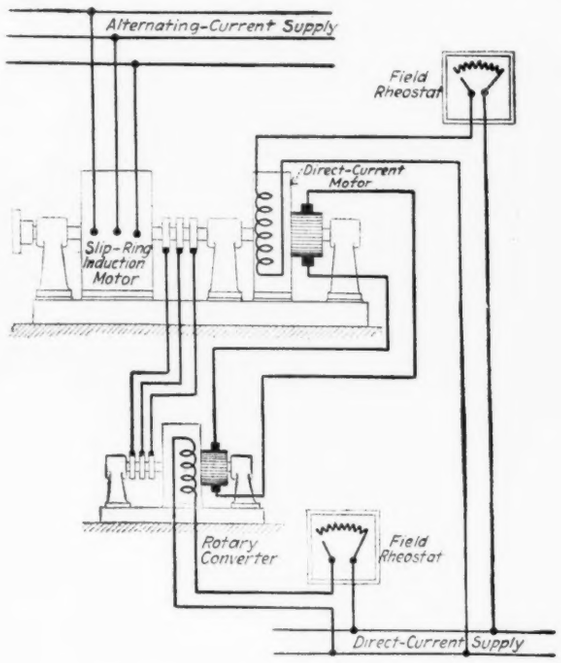


FIG. 2. SIMPLIFIED CONNECTIONS FOR ADJUSTABLE-SPEED CONSTANT-HORSEPOWER KRAEMER SET

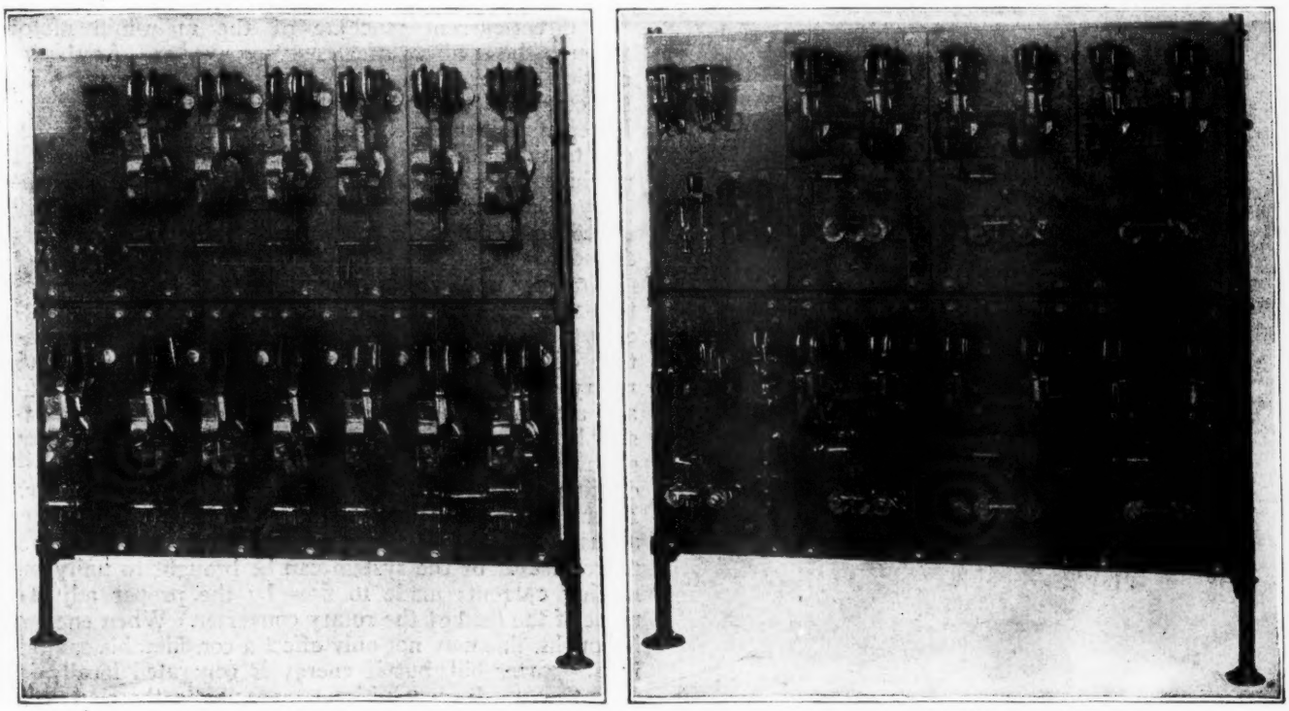


FIG. 3. ROTARY AND SECONDARY PANELS FOR REVERSIBLE KRAEMER SYSTEM CONTROL

emergency stops the master switch may be moved in the opposite direction to the starting position. The auxiliary equipment is then automatically disconnected from the circuit; the "plugging" resistance connected into the secondary circuit of the induction motor; the primary current reversed through the magnetically operated primary contactors and magnetically operated forward and oil reverse switches, Fig. 5, and the main-mill motor quickly stopped.

When the master switch is placed in the starting position, the synchronous converter is disconnected from the slip rings of the induction motor and is replaced by the starting resistance. The primary oil switch is then closed and the unit automatically comes up to the full speed of the induction motor. When rolling at this speed, the unit is operated as any ordinary induction motor. To operate at a lower speed, the field circuit of the synchronous converter is closed, and, with the field of the direct-current motor open, the slip rings of the synchronous converter are connected to the slip rings of the induction motor. The starting resistance is then disconnected in a weak field applied to the direct-current machine. The direct current generated by the direct-current machine is converted to alternating current and applied to the rotor of the induction motor at slip frequency. The speed of the rotary will increase and that of the Kraemer unit decrease until a point of stable operation is reached. By increasing the field on the direct-current machine, the speed of the unit may be reduced to the desired speed. For any particular setting the speed of the main-mill motor remains fairly constant under varying load conditions, a variation of not over 5 per cent. from no load being a fair average. The master switch may be used entirely for starting and the various functions mentioned in the foregoing. A hand-operated rheostat in the shunt-field of the direct-current machine is used for obtaining the different speeds that may be required. Unlike the master switch, as used in the Ilgner system of control for reversing mills and constantly under the guidance of the operator's hand, the master switch for the Kraemer control is seldom touched except in case of emergency after the desired speed setting has once been obtained.

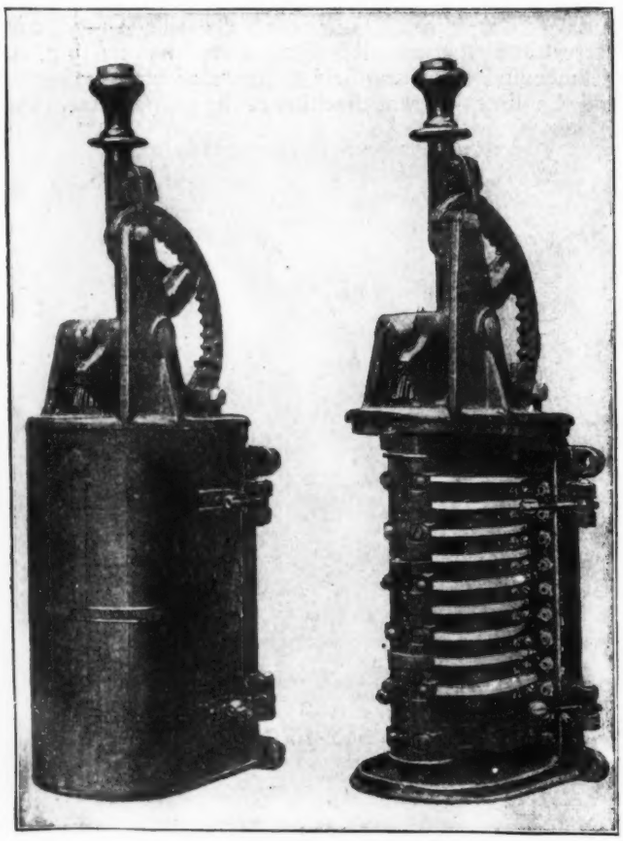


FIG. 4. DRUM-TYPE MASTER SWITCH

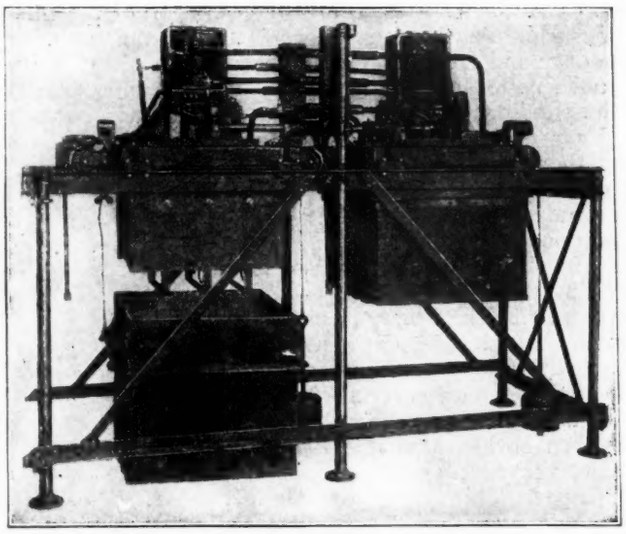


FIG. 5. OIL REVERSE SWITCH

When rolling steel, the speed is governed to a certain extent by the quality and size of the material, the reduction in area and the power requirements. Small-sized material is usually rolled at higher speed than large-sized material, and in consequence it is desirable that the driving motor should deliver a constant horsepower within its speed range. This is a natural condition as the larger product rolled at lower speed requires a greater torque. It follows that the Kraemer combination, as described, is well suited to meet this particular requirement, as constant horsepower and increasing torque with decreasing speed can be obtained throughout the speed range. This is due to the fact that the slip energy of the induction motor is returned to the direct-current machine of the main-mill motor through the medium of a rotary converter. As the induction motor is in itself a constant-torque machine, the combined turning effort of the main-mill motor or Kraemer unit naturally increases as the speed decreases due to the added torque supplied by the direct-current machine. For this reason the Kraemer unit is essentially a constant horsepower outfit and as such is well suited to rolling-mill conditions as they are actually found.

Kraemer units are in general made for a speed variation as low as 50 per cent of normal and are as adaptable to 60-cycle as to 25-cycle circuits. The combination of induction motor, direct-current machine and rotary converter requires no special machines. Standard apparatus can be used throughout. Another desirable feature of such an installation is its capability of overcoming the inherently bad feature of the induction motor; namely, power factor lower than unity. In the same manner that speed control is obtained by adjusting the fields of the direct-current machine, the power factor of the system can be brought to unity or leading currents made to flow by the proper adjustment of the field of the rotary converter. When energy is bought, this may not only effect a considerable saving in the power bill, but if energy is generated locally it adds that much more ultimate capacity to the electrical end of the prime movers. This is especially advanta-

geous if the generators are already being worked fairly well up to capacity, and in many cases might save the expense of adding more prime-mover equipment.

Fig. 6 shows the characteristics of a 1500-hp. 6600-volt three-phase 60-cycle 508-207 r.p.m. Kraemer unit when operating at half speed. It is interesting to notice the extremely high efficiency of the unit when operating at this low speed and the unity-power-factor feature of the induction motor which takes energy from the source of supply or the line. In comparison to this a study of Fig. 7 shows the characteristics of this same induction motor disconnected at the coupling from the direct-current machine and operating at a normal speed

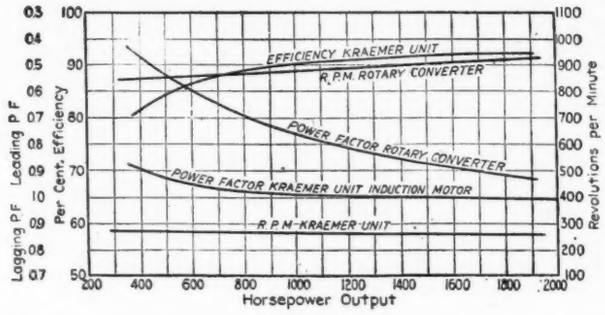


FIG. 6. CHARACTERISTICS OF 1500-HP. KRAEMER UNIT WHEN OPERATING AT HIGH SPEED

practically twice that of Fig. 6. When operating at a speed of one-half normal, the Kraemer unit has an efficiency slightly lower than that of the straight induction motor when operating at full speed. This is due to the added losses of the direct-current machine and rotary converter which have to be considered when operating at speeds below synchronism. Ordinarily, and where load conditions permit, a speed reduction of 5 per cent is obtained by inserting resistance in the secondary circuit of the induction motor, but for lower speeds the

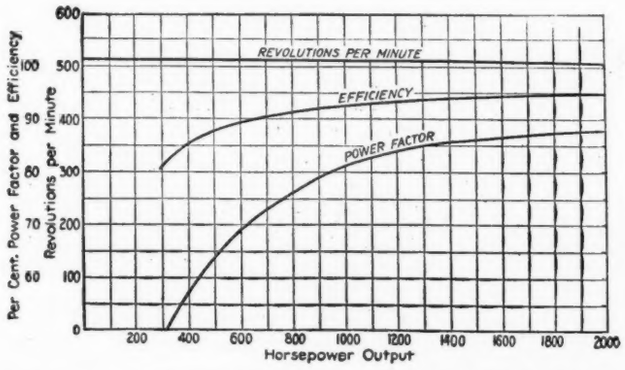


FIG. 7. CHARACTERISTICS OF INDUCTION MOTOR OF FIG. 6 OPERATING INDIVIDUALLY AT NORMAL SPEED

direct-current machine and the rotary converter are brought into action and the unit then operates as a strictly Kraemer combination.

Fig. 8 and the following formula show that the capacity of the direct-current machine and the rotary converter is dependent entirely on the nature of the load and the amount of speed control desired:

$$p = \frac{SP}{100}$$

where p equals the capacity in horsepower of auxiliary machines, S equals the per cent slip, and P equals the shaft horsepower of the Kraemer unit.

As shown in Fig. 8, for 50 per cent speed reduction and constant horsepower the direct-current machine and the rotary converter should be rated at one-half that of the induction motor. For 30 per cent speed reduction the auxiliaries should be rated at one-third that of the induction motor, etc., so that the less speed control required the smaller the auxiliaries become, consequently the lower the cost of the equipment.

A variation in speed of the main induction motor causes a corresponding variation in the voltage across its slip rings. For exact synchronous speed this voltage is a minimum, or zero, while at standstill it is a maximum in value depending on the design of the machine. Between the two points of minimum and maximum the voltage varies inversely as the speed, so it is seen that for changes in speed of the Kraemer unit a varying voltage is applied to the slip rings of the rotary converter. As there is a definite ratio of voltages between the alternating-current and the direct-current sides of a rotary converter, any change in the voltage of the former is immediately reflected by the latter. If a certain power throughout a definite speed range is to be delivered by the Kraemer unit, the commutators of both the

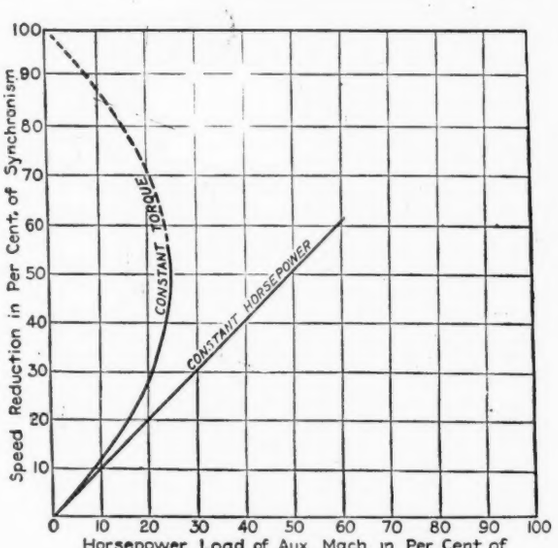

CONSTANT TORQUE
CONSTANT HORSEPOWER
Speed Reduction in Per Cent. of Synchronism
Horsepower Load of Aux. Mach. in Per Cent of Horsepower Load of Main Motor

FIG. 8. SIZE OF AUXILIARIES FOR DIFFERENT SPEED REDUCTIONS

rotary and the direct-current machine have to be made capable of handling a certain amount of current with a varying voltage. When the Kraemer units operate at one-half speed and constant horsepower, the voltage across the slip rings of the rotary is one-half of the standstill voltage of the induction motor and there is a corresponding voltage and a definite amount of current on the direct-current commutator of this same machine. At a Kraemer speed three-fourths of normal the voltage across the rings is one-fourth of the "standstill" voltage (one-half as much as before), but inasmuch as the rotary under these conditions has to handle only one-half as much power as before, the current handled by the commutator remains the same, and therefore it has a constant value throughout the speed range. This is, then, the inherent feature of the Kraemer system. It is essentially a constant horsepower unit handling constant currents with varying voltages on the commutators of both the rotary and the direct-current machines.

The question of constant torque presents a different problem. For 50 per cent speed control and constant

torque, Fig. 8, the theoretical size or physical dimensions of the auxiliary machines will be one-half the size they would have to be made if constant horsepower were required. This ratio, however, does not hold throughout the speed range as the larger the speed reduction the more the capacity of the auxiliaries gradually decrease, as shown by the dotted line, Fig. 8, until zero capacity at zero speed is required. It is also apparent that commercial units should never be made with the auxiliary equipment capacity for constant torque less than that required for 50 per cent speed reduction.

When the Kraemer unit is operating at one-half speed, constant torque, the voltage across the slip rings of the rotary is one-half of the standstill voltage of the induction motor and there is a corresponding direct-current voltage and a definite amount of direct current on its commutator. At a Kraemer speed of three-fourths normal, the voltage across the rings is one-fourth of the standstill voltage (one-half as much as before), but inasmuch as the rotary has to handle 0.75 (see Fig. 8) as much power as before, it is seen that the ratio of

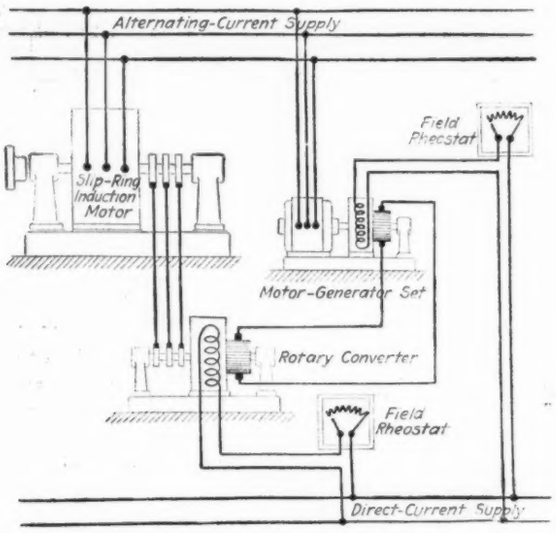


FIG. 9. SIMPLIFIED CONNECTION FOR ADJUSTABLE-SPEED CONSTANT-TORQUE KRAEMER SET

capacity to voltage decrease is not constant as in the case of the constant horsepower condition, but keeps on increasing the less the speed of the Kraemer unit is reduced. This means that the less speed reduction required, such as close to synchronism, imposes a condition where the auxiliary equipment delivers a relatively small amount of power with a relatively large amount of current to be carried by the commutators.

To meet such a condition if it were actually to prevail, and in view of the facts as already presented in the foregoing, the combination of machines shown in Fig. 9 could be used. It consists of a standard induction motor and a rotary converter, the same as in Fig. 2, but in place of the direct-current machine on the Kraemer set, a separate high-speed motor-generator set is used. This latter set comprises a direct-current machine and an induction generator returning energy to the line.

In reality, a constant-torque Kraemer unit combination of machines, such as the constant-horsepower combination shown in Fig. 2, would require auxiliary apparatus just as large for a constant-horsepower outfit on account of the currents to be handled by the commutators of the rotary and the direct-current machine. In the constant-torque arrangement shown in Fig. 9, the rotary converter is the same physical size as would be used in the constant-horsepower arrangement of Fig. 2. The reason for using a separate high-speed motor-generator set in place of the direct-current machine becomes apparent when it is considered that the Kraemer unit may run at a speed of, say, 200 r.p.m., while the motor-generator set may run at 1200 r.p.m. While the direct-current machine of the high-speed set has to handle just as much current under any load condition as the apparatus in Fig. 2, the high-speed set cuts down the initial cost of the whole combination over what it would be if the combination of Fig. 2 were used.

In Fig. 8 the losses of the main motor have been neglected, but this affects the capacity of the auxiliary machines very little. For a 1500-hp., 508- to 257-r.p.m. Kraemer unit of the constant-horsepower type, the direct-current machine should be rated at 750 hp., 1,200 amp., 508 to 257 r.p.m. and the rotary at 600 kw., 500 volts direct-current, 370 volts alternating current, three-phase, 30 cycles, 900 r.p.m.

It is often advisable in the larger-sized units to have the rotor of the induction motor wound six-phase with six slip rings, for this gives a more economical design of rotary converter than could be obtained with a three-phase machine.

From the operating point of view the Kraemer system for adjustable speeds involving the combination of standard simplified machines and simplified control apparatus, especially for steel-mill service, tends toward low maintenance cost, long life, maximum production, high factor of safety and, still more important, continuity of service.

Miners Earn $10 to $12 Per Day

Many of the miners, says *Coal Age*, have plenty of opportunity to work, but prefer to be idle a large part of the time, is a statement made by the bituminous operators of the Central Competitive field. A statement by the operators says that they purpose to make an effort to convince the commission that the miners have plenty of opportunity to work, but that many of them prefer to be idle a large part of the time; that their wages are high and that the cost of living to them has not gone up to the high figures which their officers have given.

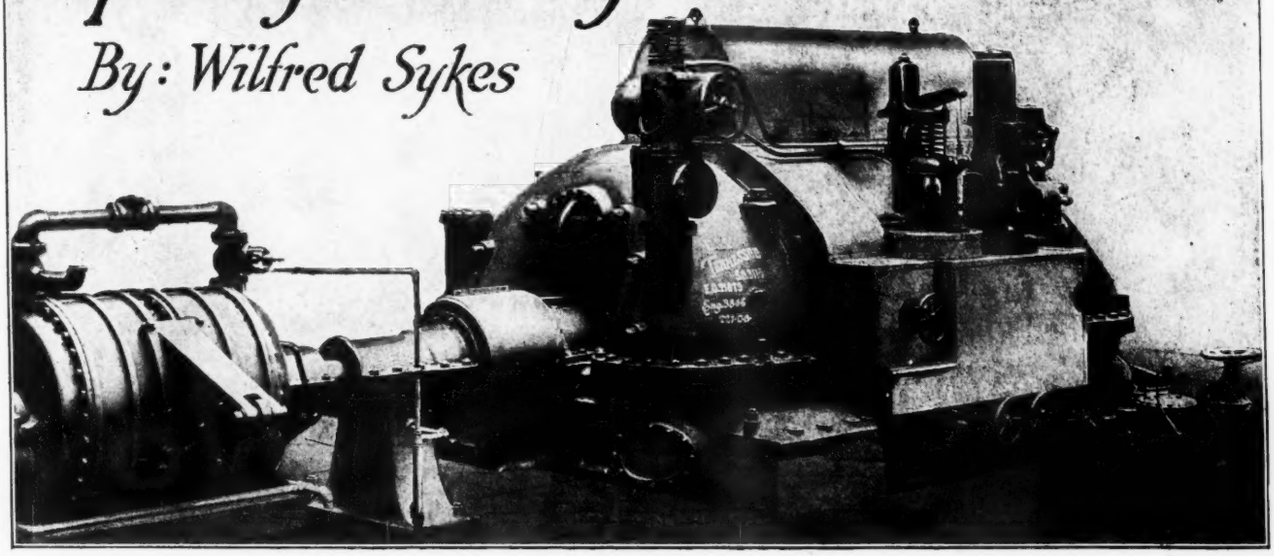
"The operators have maintained," says the statement, "that the differential and similar issues raised by the miners have been dragged in in an attempt to befog the real issue, which, they say, is purely one of the straight wage advance. These other issues interjected by the miners have been characterized by the operators as attempts to obtain what amounts to an additional wage increase by a subterfuge.

"Payroll evidence will be offered by the central competitive operators to show that the miners, in most fields, can make from $10 to $12 a day, and that $15 a day can be earned readily in the richer mining districts, which operate from 250 to 275 days a year. It will be shown that comparatively few of the men in the field work steadily, and that if they did their yearly earnings would be increased by from 15 to 20 per cent. This, they will show, would not add to the present cost of producing coal.

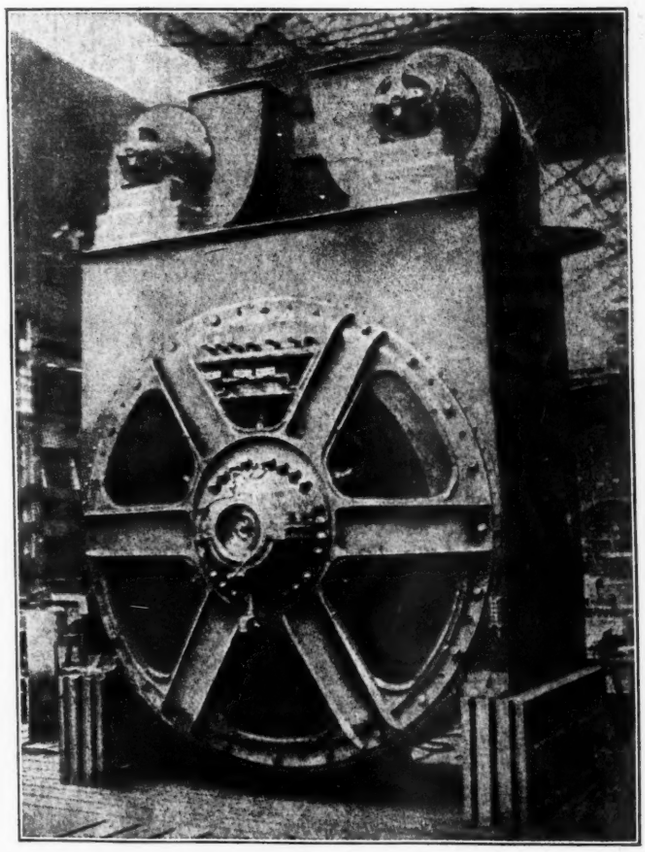
"The cost of living in mining communities will be presented to refute the assertion of miners' representatives that the cost of living in mining centers increased as much as 125 per cent during the war. The operators will show that in no mining communities have rent and fuel increased at all, while the cost to miners for food and clothes has not been such as to create any such advance in living cost as the miners have maintained before the commission."

Propelling Machinery for U.S.S. Tennessee*

By: Wilfred Sykes



THE propelling machinery for the U. S. S. "Tennessee"† consists of two turbo-generators and four propelling motors. The switching apparatus is so arranged that either generator can drive all four motors or with two generators in operation each will drive two motors. The turbo-generators have a combined capacity of about 26,500 kw., which will be required to drive the motors when operating under the maximum conditions, each then delivering 8,375 hp. The speed of the motors is varied by varying the revolutions of the turbine within certain limits, and the motors also have two sets of poles, so that with the turbine running at full speed there is a speed reduction of about 12 to 1 and 18 to 1 to the propellers. The turbines, one of which is shown in the headpiece coupled to a water brake, are designed to operate with a steam pressure of 250 lb. per sq.-in., 50 deg. superheat and with a vacuum of about 28½ in. The turbine speed under normal operating conditions is about 2,130 r.p.m. maximum, and on test the machines have been run to 2,480 r.p.m. The speed of the turbines is varied by means of a specially designed governor which, instead of being loaded by a spring as is usual, is arranged so that the centrifugal weights act against an oil pressure on one side of a piston. With such an arrangement the speed at which the governor will affect the steam supply will vary with the oil pressure; the turbines can be set to run at any speed desired. A specially designed variable-pressure valve is provided in the control room, for the purpose of operating the governors, and the only connection between the control room, where the speed is varied, and the turbine room is an oil-pipe connecting to the governor piston.

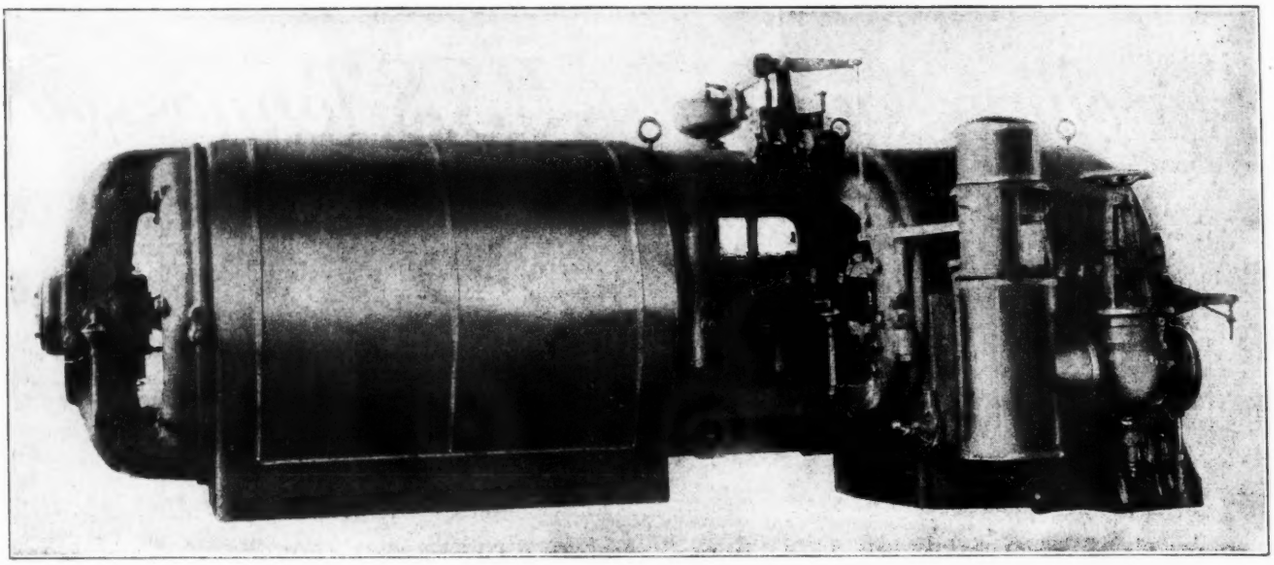


MAIN PROPELLING MOTOR WITH BLOWERS ASSEMBLED

The generators are three-phase 3,400-volt machines, operating at about 35 cycles at full speed. They are standard construction, except that special provisions have been made to avoid salt deposits in the windings. This is a trouble that is likely to occur where machines are operated in salt-laden air.

The guarantees for this ship based on 250-lb. steam pressure, 60-deg. circulating water with no superheat, are at 21 knots, 11.9 lb.; 19 knots, 11.65 lb.; 15 knots, 12.1 lb.; 10 knots, 15.45 lb. These figures include all the power required for driving the circulating pumps, condensate pumps, ventilating blowers for machines and excitation; that is, the auxiliaries for the main units.

*A. I. E. E. Journal, Jan., 1920.
†Power, Aug. 7, 1917.



Steam-Turbine Governors—Governors of 75- to 3,000-Kw. Curtis Turbines

By CHARLES H. BROMLEY

Treats of the operation, care and adjustment of the single and double-deck inertia governors used on Curtis horizontal turbines of moderate capacities. This article applies to Curtis turbines of 75 to 3,000 kw., though other forms of valve mechanism have been used on units of these ratings.

SINGLE-DECK INERTIA GOVERNORS—It is important that the operating engineer acquaint himself with the Curtis inertia governor and combined throttle and trip valve. The automatic throttle shown in Fig. 10 is in wide use, though on machines now being furnished this particular type of valve is used only in special cases. It should be understood that the only difference between the single- and double-deck governors is that the latter is simply two single decks, one over the other. The operation of both is the same, the double-deck governor being used for larger units than those having the single-deck type; they are used also for low-pressure turbines. Both are driven by a secondary shaft geared to the mainshaft.

The governor is of the inertia type and functions because of the unbalanced force due to inertia and centrifugal effect of two weights *B* and *C*, Fig. 2, pivoted on ball bearings *D* and *E*. The centrifugal effect and inertia are opposed by the helical spring. The weights are mounted on knife-edges. The center of gravity of the weights is inside the radius of the point of support and in advance of it with respect to rotation. This decreases the tendency to "jump" on quick changes of load.

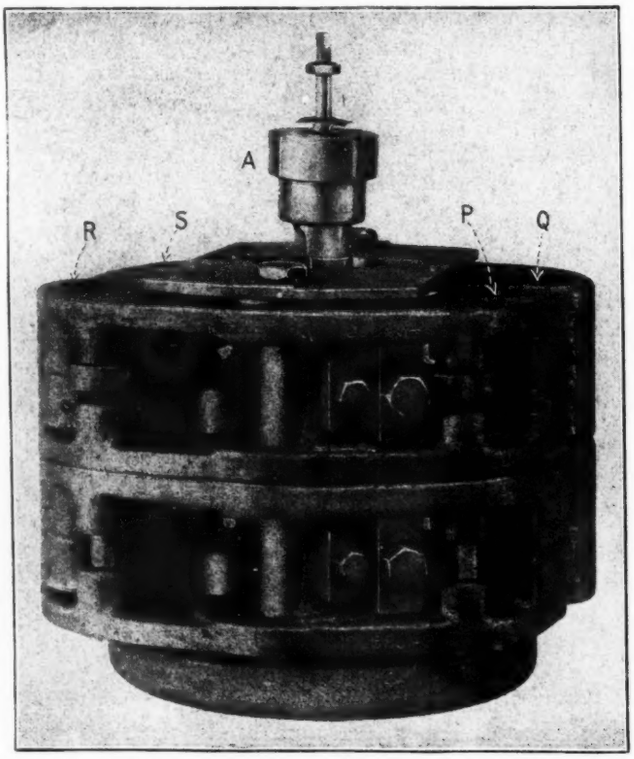


FIG. 1. THE DOUBLE-DECK GOVERNOR

The effect of revolving the weights is to bring the points *J* and *H* together. At each of these points is a hollow link *K*, Fig. 3, and these links rest in the ball joints *H* and *J* and support a thrust block *A* at their upper ends. Therefore when the ball joints *H* and *J* move toward each other the thrust block is lifted, and is lowered when *H* and *J* move apart on the reduction of speed. The thrust block transmits motion to the levers that operate the governor throttle valve. The links *F* and *G*, Fig. 2, give the weights a parallel motion. Fig. 1 shows a view of the double-deck governor.

Adjusting the Governors—Assume that the speed must be raised or lowered without materially changing the "range." To do this decrease or increase the weight by taking out, screwing in, or substituting lead or steel weights, which screw into the tapped holes, *P*, *Q*, *R* and *S*, Figs. 2 and 3. *Remember always to have plugs of the same weight in the diagonally opposite holes in both*

weights. For example, do not have two plugs of different weights in the holes *R* and *Q* or holes *P* and *S*. This upsets the balance and may cause trouble.

Any change in spring tension will affect the width of regulation; decreasing the tension broadens it and

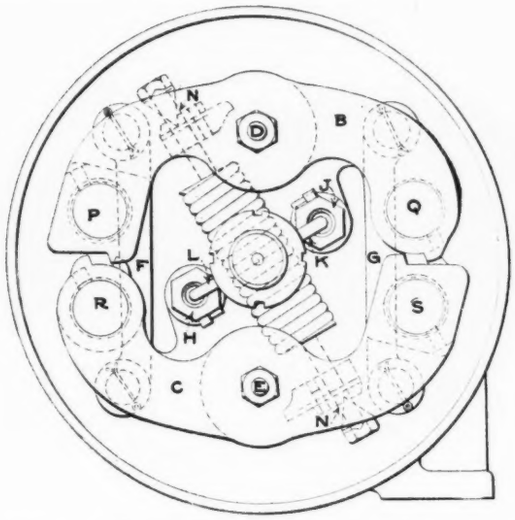


FIG. 2. LOOKING DOWN UPON "DECK" OF THE CURTIS GOVERNOR

increasing the tension narrows it. When the regulation is so affected the change in speed is about twice as rapid at the lower end of travel as at the upper. The regulation can be further broadened by screwing the plugs farther into the springs, but this practice is not

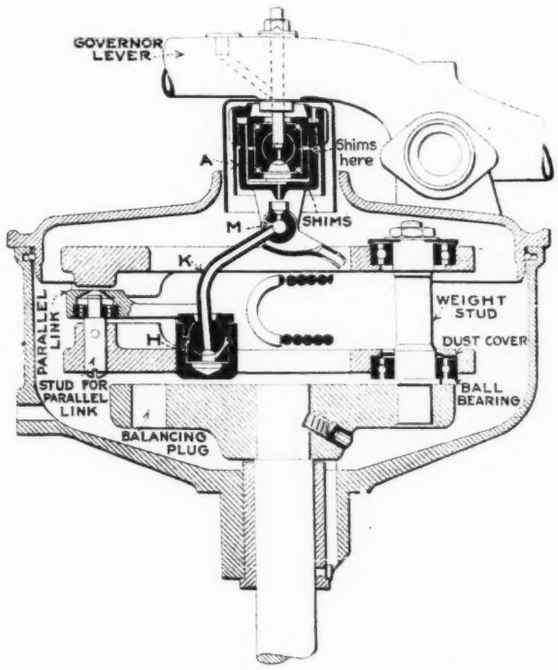


FIG. 3. SECTION OF THE GOVERNOR

advised except when the other two means are not sufficient.

By applying the two methods of adjustment in proper proportions all desired speeds possible with the design of the governor may be obtained. Suppose the regulation is narrow and high and it needs to be broadened, add weight and reduce the tension of the spring at the same time. Assume that the regulation is high and broad and it is desired to narrow it, add weight until the speed is reduced below normal (not too much) and then increase the speed by increasing the tension of the spring.

Making adjustments frequently, with a trial after each adjustment, is better than going to extremes. As with every governor, adjustments will be made quicker and easier as one becomes familiar with it. The tension broadens the width of regulation. To raise or lower the speed without affecting the width of regulation add to or take from the weights in the parallel links.

Lubrication of the Governor—The oil pump is driven from the turbine governor shaft, as usual, and consists essentially of two gears running in close mesh and hav-

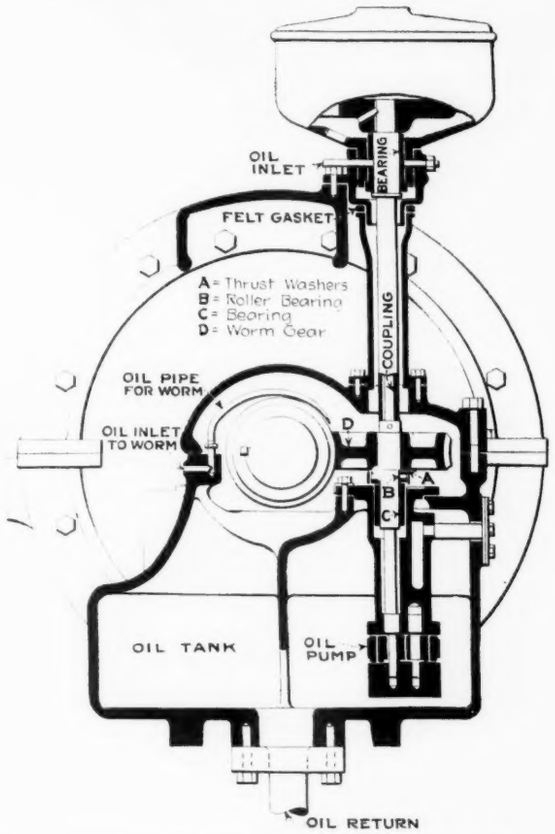


FIG. 4. SECTION OF THE CURTIS GOVERNOR, SHOWING LUBRICATION FEATURES

ing little clearance in their casing. The governor transmission needs but little oil after it has been flooded. The oil pump, governor shaft and attached parts are indicated in Fig. 4 which shows clearly how the parts of the governor proper are lubricated.

Governor Valve Connections—Connections of levers between the governor and governor valve are shown in Fig. 5 and in the headpiece on page 414. All governors and their connections are properly adjusted by the builders before shipment, and the rods, knuckles, etc., prick-punched for tramming; the tram is furnished with the turbine.

The Governor Valve—Before giving directions for resetting the governor rods and gear generally, the governor valve must be understood. Fig. 6 looks more complicated than the valve appears when dismantled.

Briefly, the valve consists chiefly of six individual valves and seats *F*, *B*, *A*, *C*, *D* and *E* all on one rod and all in one long cylinder, the valves becoming progressively larger from the bottom valve to the top valve. Each valve has its own separate passage for steam to the turbine. The valves are moved by steam pressure applied to the operating piston *N*, the steam admission to the

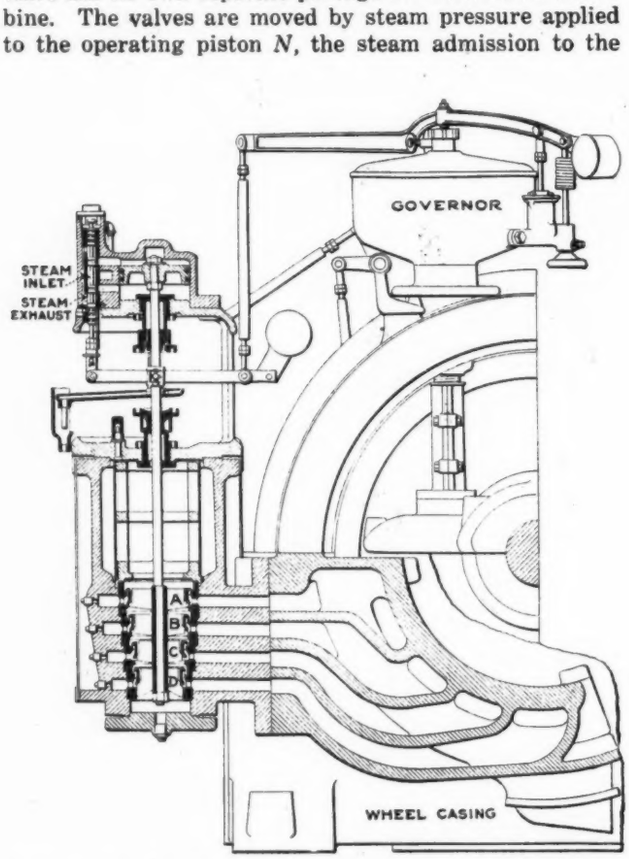


FIG. 5. SECTION OF THE GOVERNOR VALVE, SHOWING THE STEAM PASSAGE TO THE NOZZLES

operating cylinder being controlled by the pilot valve *G*. Notice that the steam passages from the pilot valve to the operating cylinder are criss-crossed. The valves open one at a time in the alphabetical order shown—that is, *A*, *B*, *C*, *D*, *E*, *F*—and the steam goes to the first-stage nozzle and wheel, as shown in Fig. 5, although the valve here is slightly different. As the lugs on the valve spindle engage the valves, each one is lifted from its seat. Fig. 7 shows the valve dismantled.

When the turbine is at rest, the pilot valve is in a position to admit steam under the operating piston. When the throttle is opened and the turbine picks up speed, the governor, through its levers, moves the pilot valve so that it now admits steam above the operating piston. The governor valve now begins to close until the governor takes a definite position, that is, the floating lever *K*, Fig. 6, fulcrums on the pin at the extreme right, and the pilot valve is then in a neutral position. When the load is put on, the governor responds by shifting the pilot to admit steam *under* the operating piston, and this operation lifts the valves until the speed is restored.

The reader is now likely aware that this multiple valve has one or more of its six valves *full open or closed all the time*, avoiding throttling. Leakage from one valve to another is avoided by the use of asbestos packing (gaskets) under each valve-seat ring frame, as shown at *J*.

The steam piping to the pilot valve is connected to the entrance side of the throttle valve, and no valve should be put in this pipe. If a valve should be put in and by ignorance or accident closed, it would result in the turbine running away if the load were suddenly thrown off.

Resetting the Governor Gear—By gear is meant the rods, levers, knuckles, etc., attached to the governor and

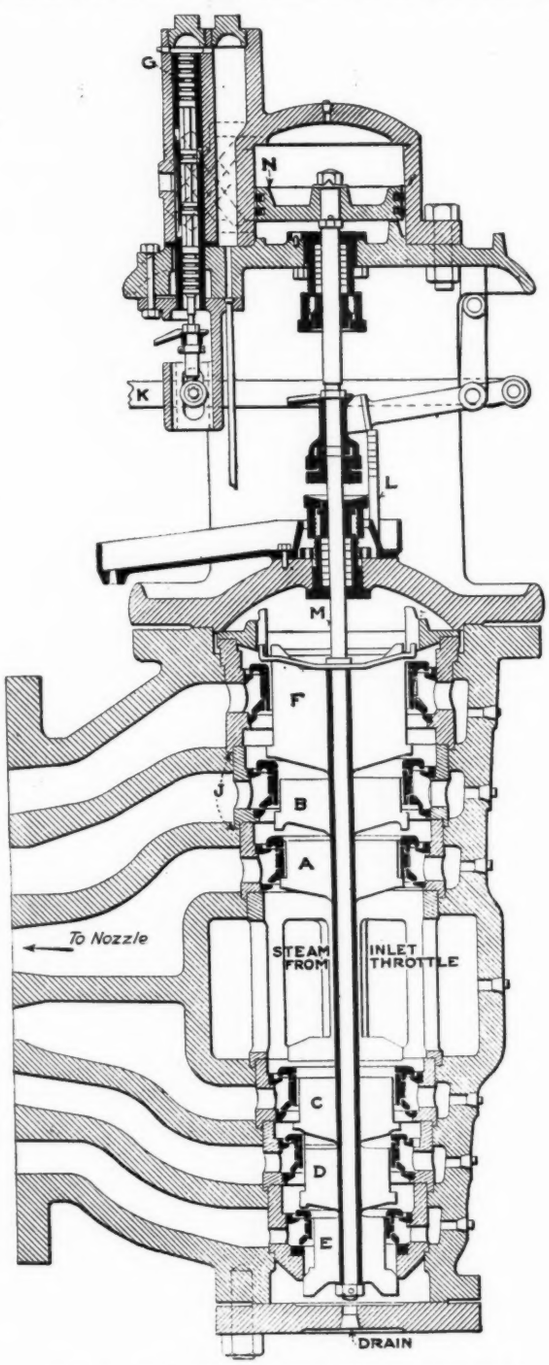


FIG. 6. SECTION OF THE CURTIS TURBINE GOVERNOR VALVE

As the governor lifts the valve rod the valves open full, one at a time, in the order A, B, C, D, E and F, thus there is no throttling by any one valve.

connecting it with the governor valve. These parts are properly set before the turbine is turned over to the purchaser, and the parts prick-punched so that they may be trammed; the tram is furnished by the builder.

Suppose the tram marks have been obliterated or new parts furnished and the gear is to be reset. Here are the directions; See that all joints are free to move and that there is no serious backlash. Disconnect the synchronizing spring from the governor lever and adjust the dashpot piston, Fig. 8, within about $\frac{1}{4}$ in. from the dashpot cover. Remove the lagging from the steam chest and insert cocks in the $\frac{1}{4}$-in. tapped holes (shown at the right and plugged) leading to the upper valve *F*, Fig. 6, and to the third valve *A*. An arrow is stamped on the lower half of the coupling shown just to the left of *L*, Fig. 6, and a valve indicator *L* indicates the position and travel of the various valves. Open the throttle and bring the turbine to speed, mark the position of the arrow on the indicator when all valves are closed; that is, the instant when practically no steam is blowing out of the cock at the valve *A*. Throttle the steam until all the valves are open and again mark the position of the arrow on the indicator. The distance between these two marks should be about two inches.

It may be necessary to shorten the connection rod to obtain the travel needed for the valve stem to open all the valves or to lengthen it so it will close all the valves. It is desirable to have the pilot lever approximately horizontal for the mid-position or neutral position of the pilot valve. This position may be had by readjusting the length of both the governor connection and the pilot valve. Lengthening the governor connection will require lengthening the pilot valve and vice versa. Check the valve travel after any readjustment in active length of rods or connections. This is important.

Now attach the synchronizing spring and with it set in mid-position, check and, if necessary, make slight readjustments. The maximum and minimum travel of the synchronizing spring should be limited by pins to permit not over 2 per cent increase or decrease in speed. More than 2 per cent will throw too much effort on the main governor and consequently cause rapid wear of that governor.

Finally, check the no-load speed and if possible the full-load speed. If the speed is high or low, adjust the main governor as described in the early paragraphs of this article. Now tram the various parts and prick-

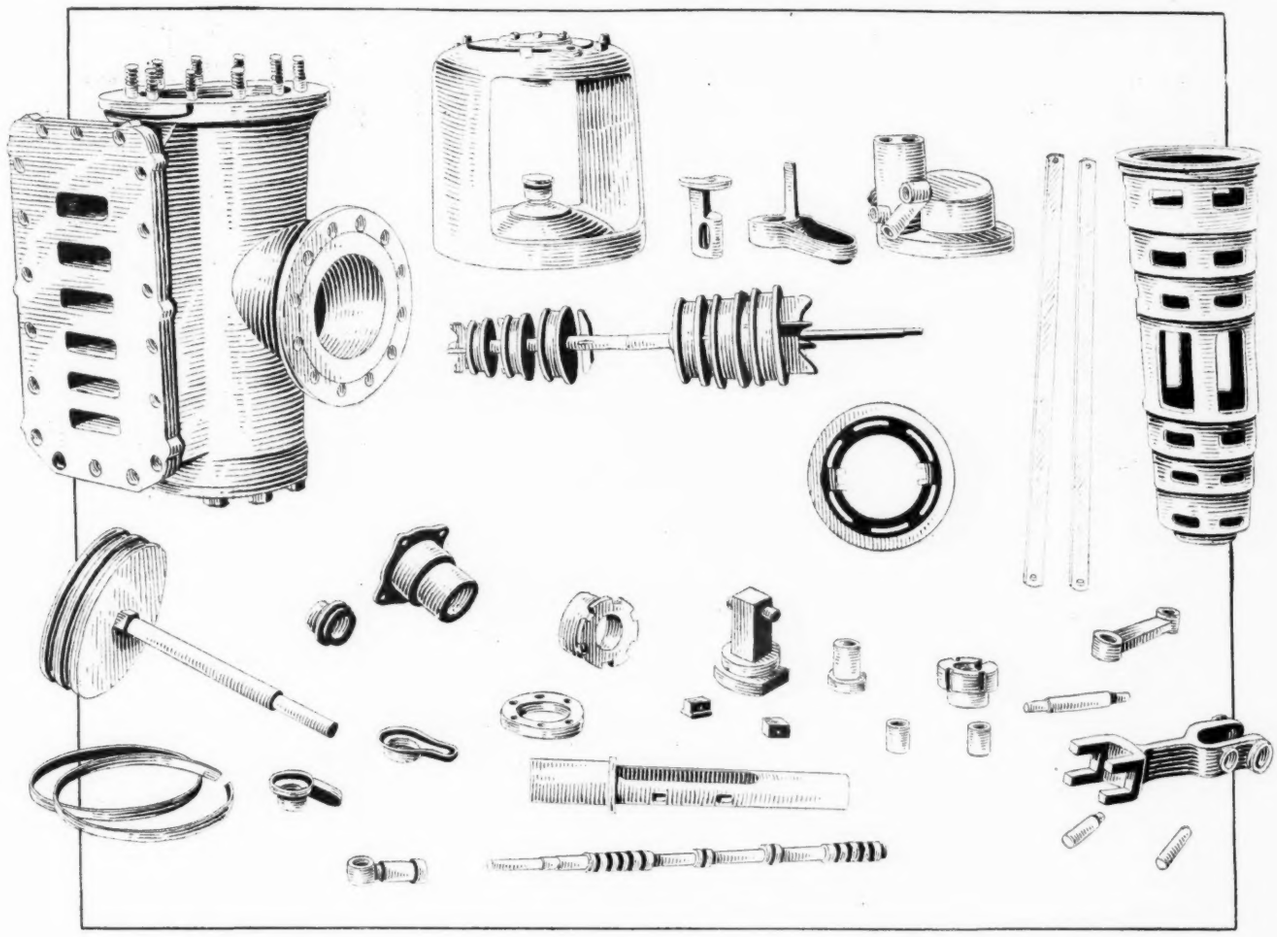


FIG. 7. THE MEDIUM-SIZED CURTIS TURBINE GOVERNOR VALVE DISMANTLED

punch them so as to guide you or other operators in later resetting the connections.

As a guide in making adjustments it is to be noted that the maximum travel of the governor is about $\frac{7}{16}$ in. The working travel is limited to about $\frac{5}{16}$-in. The travel of the main valve stem *M*, Fig. 6, is 2 in. from the position of the first valve closed to the valve wide open. The travel of the pilot valve for full opening and closing of the ports is $\frac{1}{2}$ in. To close the main valves the governor transmission travels upward, while the connection rod, pilot valve and main valve stem travel downward.

The Emergency Governor—Fig. 9 shows the emergency governor. This particular type is used on all Curtis turbines from 500 kw. to 2,500 kw. It consists essentially of two clock springs under tension against stops on the emergency disk *A*. The tension of the

springs is such that at about 7 per cent above normal speed the centrifugal effect overcomes the springs, and at 10 per cent the ends of the spring move about ⅜ in.

8. Increasing the tension of the spring by adjusting the screw into the spring holder raises the speed of the operating governor, slightly narrows the effective range

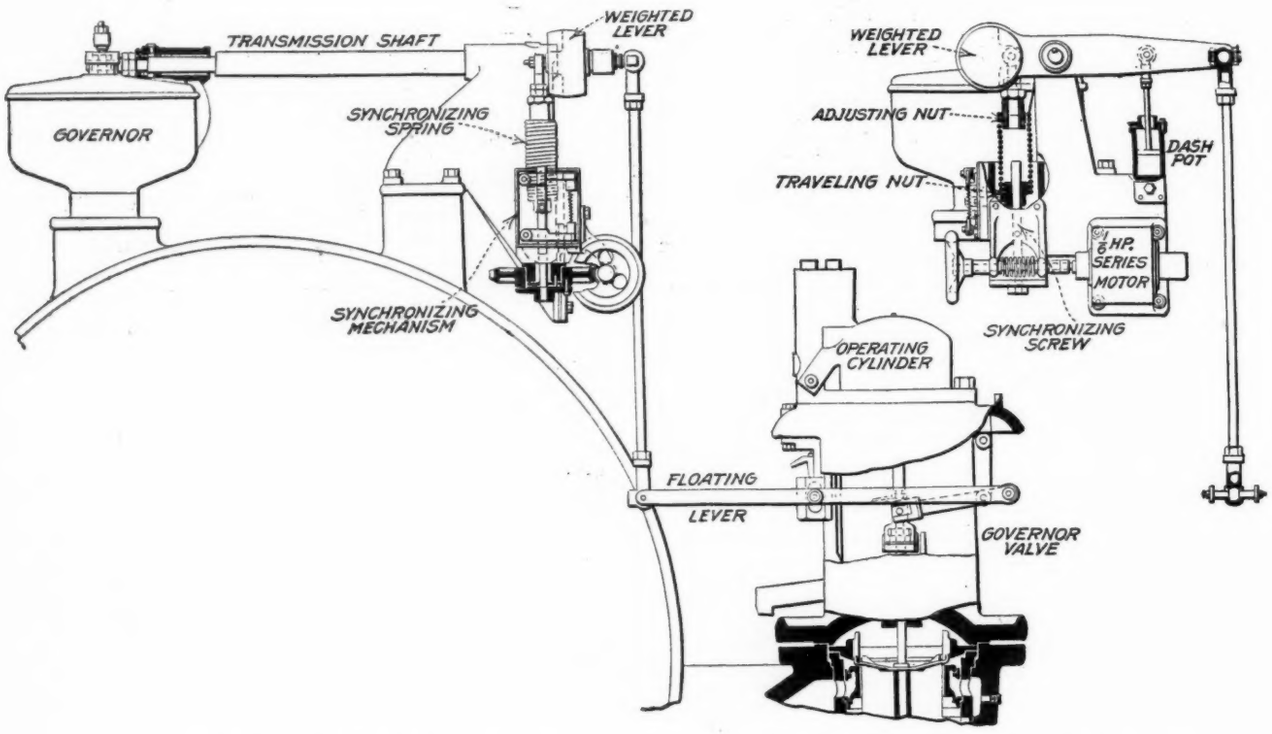


FIG. 8. SYNCHRONIZING MECHANISM AND CONNECTIONS WITH GOVERNOR AND GOVERNOR VALVE

from the nuts and trip the trigger *A*, Fig. 9. This allows the throttle, Fig. 10, to drop to its seat.

To reset the emergency, turn the handwheel on the throttle valve to its closed position, raise the resetting handle *B* and open the throttle.

The Synchronizing Mechanism—This is shown in Fig. 8. Increasing the tension of the spring by adjusting the screw into the spring holder raises the speed of the operating governor, slightly narrows the effective range of the synchronizing spring and lowers the speed of the operating governor. In case readjustments are made, note that the spring should not be shortened enough to come within one-eighth inch of closing when the upper limit of travel of the lower plug is reached. Keep the wormshaft and gear lubricated. The motor

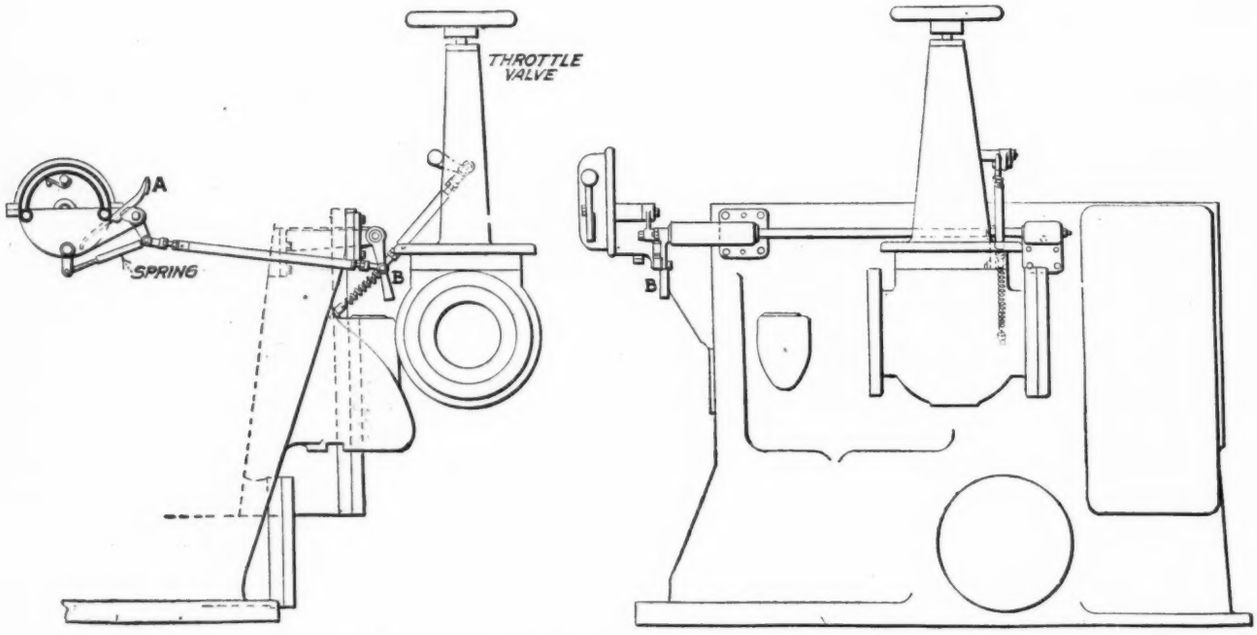


FIG. 9. SHOWING THE CONNECTIONS TO THE OVERSPEED STOP GOVERNOR OF THE CURTIS TURBINE

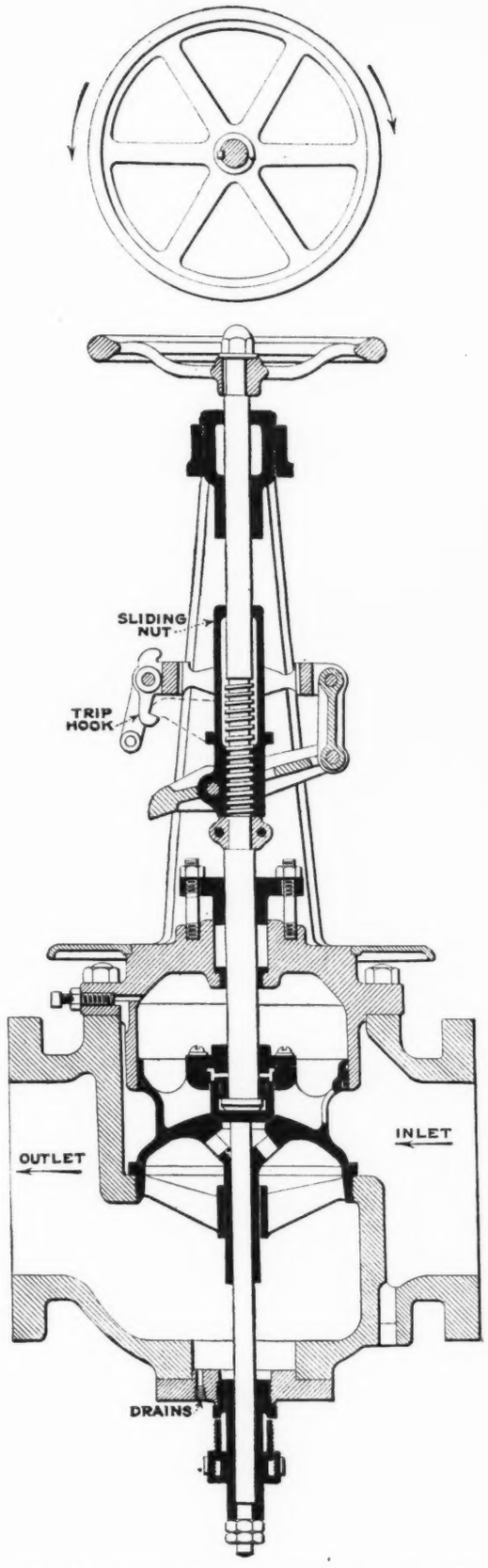


FIG. 10. AUTOMATIC THROTTLE VALVE USED WITH MODERATE SIZED CURTIS TURBINES

Many are in use but it is now applied to new machines only in special cases

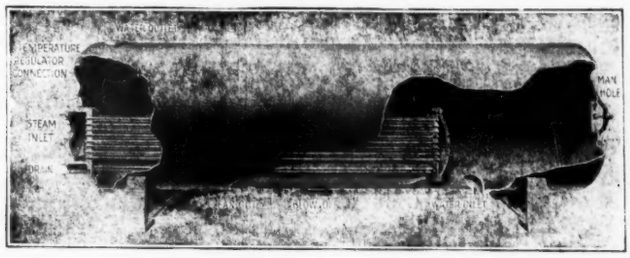
journals are ring lubricated, therefore keep the oil reservoirs full.

Have in mind that this article applies particularly to Curtis turbines of capacities ranging anywhere from 75 to 3,000 kw., although on some machines of this type and these ratings other valve mechanism will be used.

Russell Storage Heater

Storage-type heaters which insure a reservoir of hot water have been used in their general form for years. In these heaters exhaust or live steam is supplied to a heating element, where it condenses and heats the water in the tank.

The Griscom-Russell Co., 90 West St., New York City, has recently placed on the market the Russell storage heater, intended to supply hot water in hotels, apartment houses, factories, etc., and this heater departs from the



SEMI-SECTIONAL VIEW OF THE RUSSELL STORAGE HEATER

general practice as regards the construction of the heating surface.

The Russell heater is designed with a number of straight tubes in the steam element, and of sufficient length to insure that the required heating will be taken care of and that all the steam will also be condensed when it reaches the rear end of these heating tubes. It is therefore only necessary to provide an area of drain-tube section sufficient to carry the condensation back to the steam head.

The heating surface consists of seamless drawn brass tubes expanded into a fixed tube plate at one end and a floating tube plate at the other end, thus permitting expansion and contraction of tubes without strain on the tube joints.

The shell is regularly furnished of welded construction, but can be riveted if preferred. A manhole is provided to permit easy access to the shell for inspection and cleaning.

Too much stress cannot be laid to the fact that the failure of high-head hydraulic pressure-regulating apparatus to function properly may cause pipe-line breaks which would often cause loss of life or considerable damage to property. The governor and governor connections of hydraulic pressure regulators should be well lubricated and examined regularly. Hydraulic pressure regulators that do not function during the normal operation of the plant should be operated occasionally to be sure that they do not stick. A good grade of packing should be used in the packing glands of hydraulic pressure regulators and the adjustment of the glands should not be trusted to anyone who is not practiced.

On the Road with the Refrigerating Troubleman

By J. C. MORAN

Called to a distant job, the present one is left in charge of an assistant and the purchaser's chief engineer. Hurriedly returning, he finds the compressor unable to be operated because of violent thumping, with suction pressure of 70 lb. He finds and corrects the trouble and breezily tells how.

I ONCE had charge of installing a large air-conditioning plant in a factory in the South. Before the job was finished, I was sent out on another case where they were having trouble and the work was turned over to an assistant. Before I left, we talked over testing and charging the system and the precautions that should be taken before starting the plant. I went away confident that there would be no trouble, as my assistant had worked with me for over a year and the chief of the plant assured me that he had had a long experience with refrigerating machines.

The work in the plant several hundred miles away finished, I wrote the home office for further instructions and received a somewhat sarcastic answer. I was informed that they had been unable to start the plant left in charge of the assistant and that I must get back there quickly because the purchaser was threatening to cancel the contract.

The Assistant and Chief Have Trouble in Starting the Plant

Arriving there, I found the assistant and the chief calling each other names, and I got my share. They had been trying for nearly a week to get the plant going. Sometimes the machine would start to pound so hard that it would nearly jump off the foundation, about the same as if there were a lot of water in the cylinder; at other times it would run hot. They had been unable to get the frost to come back on the suction line or even at the suction outlet of the expansion coils, except for a short time on two occasions. They had also been unable to do any cooling worth while in the water coolers through which the air passed. The original water temperature at this time of the year was about 80 deg., and it was required that the temperature be carried at about 40 deg. as it came off the cooling coils. So far they had been able to reduce the temperature only 10 to 15 deg. and in most cases only 4 or 5 deg.

Examination of the whole plant from top to bottom showed nothing wrong. We had about 600 lb. of ammonia on hand, and thinking that the trouble might be due to the charge being too light, we put in all of it.

There were four coolers, and to avoid complications I decided to break them in one at a time. Beginning on the one nearest the engine room, so as to be as close to the compressor as possible in case of trouble, we started the compressor slowly and then opened the expansion valve on this coil a little at a time every ten or fifteen minutes until the discharge line began to get cold and a few slight thumps in the cylinder indicated that there was liquid coming over with the suction gas. The suction pressure kept going up, and when the thump was heard in the cylinder, it was 70 lb. The assistant and the chief gave me the laugh when I continued to operate at this pressure, saying that no self-respecting machine had ever been known to do any work at such a suction pressure and no frost on the suction line. The suction line began to sweat for its entire length, and I stuck close to the compressor with hand on the discharge line. Soon the line began to get cool, and I promptly went out to the cooler and pinched back on the expansion valve, when the discharge again warmed. This was repeated regularly and in the meantime both the suction pressure and the water temperature were rapidly coming down.

The suction line began to show frost, and the suction pressure had dropped to 40 lb. The temperature of the water leaving the cooler was 38 deg., and they were able to start the fan for the first time and try the air conditioning and circulating system on one room.

We then cut off the feed on this coil to about half of what it had been up to this time and cut in one of the other coils a little at a time. It was not long before the suction pressure took a jump and the frost came off the suction line. In a few moments the discharge became cold again and the cylinder began to thump. The suction pressure by this time had climbed to 60 lb. There was no secret as to where the liquid came from. It was realized that for quick results it would be necessary to again cut out the cooler in which the temperature had come down. It was decided to bring each one down in succession, as the water temperature, once it was down, would not rapidly rise before all coolers were of uniform temperature.

The procedure with the other three coolers was the same as with the first one and with the same result. When the last one was down to 45 deg., the temperature of the water in the first one had risen to only 48 deg., while in the others it was lower. We then began to cut them in all together.

Each expansion valve was gradually opened until the discharge began to get cold, when they were pinched back slightly until the suction line frosted. It was then a simple matter to detect which one of the coils was getting the most liquid and adjust the expansion valves accordingly. The line that frosted back the most was, of course, to the cooler that was getting the most liquid, and all that was required was to pinch back on this valve and possibly open up a little more on some of the coils on which the frost was not so heavy until they were all working at full capacity. I then told the master mechanic to start the fan system on all the rooms.

The Cause of the Trouble

The owner and everyone else were pleased. The trouble arose because the chief and the assistant were not posted on fundamentals. In starting with the water temperature up around 80 deg., the temperature of the ammonia boiling on the inside of the coils would be somewhere between 65 to 75 deg., and of course the gas evaporated would be at this or higher temperature as it passed along through the suction line. If there was any liquid carried along, the temperature would be about the same as it left the cooler, and as a consequence it would be impossible to frost the suction line. The temperature of the gas and that of the suction line were between 30 and 40 deg. above the freezing point. This caused the high suction pressure at the start, which, by the way, was just what was wanted to get the most work out of the machine in the shortest time. The pressure corresponding to 70 deg. of the boiling

ammonia in the coils is 114 lb. So that is the pressure that could be expected, or something near it if we had been able to adjust the feed to full capacity at once. Then, again, there was considerable friction loss in the line when taking all the gas out of one coil, as I did at first, and this will also in a large measure account for the fact that the pressure never went much above 70 lb. at the start. In addition the temperature of the water had dropped several degrees before the coils were working to advantage.

Here is where the assistant and the chief got into trouble. First they tried to hold the suction pressure down to about 25 lb. for the reason that they had never seen a machine operating any length of time at a higher pressure, and they concluded, therefore, that it was necessary to keep the pressure below this point; the lower the pressure the more work would be done, they believed. In doing this they could only open the expansion valves a little, and therefore but a small amount of ammonia would be evaporated and the gas would come back to the compressor highly superheated. So there was little work done and the suction line would not frost.

A few times they had tried to operate the machine at the higher suction pressure, but they began with all coils in on the line. With it being impossible to frost the suction line at this high suction pressure and temperature, there was no indication when one coil was getting too much liquid. And the only place where it could be checked—until it started a pound in the cylinder—was to feel of the discharge line, which would get cold. This neither of them had thought of, and even so, it would give no clue to which one of the coils was doing the mischief and throwing the liquid in the line. However, they could have pinched back on all of them until the pressure came down enough to frost the line, when they could have made the proper adjustment. As a consequence they nearly wrecked the machine a couple of times when the liquid came back in heavy slugs, and they decided that something was wrong with the plant instead of themselves.

The Troubleman Relates Another Similar Experience

I had a similar experience with a small direct-expansion system installed in a sanatorium for cooling the drinking water, of which a large quantity was used and the temperature before cooling was often near 85 deg., from which it was reduced to 45 deg. That is, they desired it to be at a temperature of 45 deg., but so far they had been unable to come anywhere near this figure. In addition to cooling the drinking water, the machine served a small refrigerator in the kitchen.

The man in charge was of the old school and could never think of anything being done any other way than the way he had seen it done. He had worked in a fish-freezing plant where they had been unable to do business at temperatures in the coolers much above zero. As a consequence he had formed the rockbound opinion that no machine could do work unless it was operated at or near zero suction pressure. "The lower the pressure the more the work," was his argument.

Well, he applied this reasoning to the cooling of the drinking water and it did not work. Neither did he get results in the kitchen refrigerator. And as usual he blamed the machine.

The chief stated that he wanted a temperature of about 40 deg. in the kitchen refrigerator, and I found it had an abundance of pipe for the work required. By keeping the pipes clean they ought to do the work with a temperature difference between the air on the outside of the coil and the ammonia liquid on the inside of about 5 to 8 deg. This would mean a temperature of the boiling ammonia in the coil of about 32 deg. at the lowest, which corresponds to a suction pressure of 45 pounds.

The coil in the water cooler was about double the size necessary for the work it had to do. If it was turned on full, it would do the required work all right and bring the water temperature down to the freezing point, but the suction pressure was too high for the kitchen refrigerator to do its work properly.

To balance the system and make it simpler to operate, I connected a bypass into the water-cooling coil so that by opening it one-third of the coil was eliminated, the gas going direct from two-thirds of the coil to the suction line, leaving the last third of the coil out of service. In other words, the two-thirds of the coil had to do the same work that the whole coil had done before, and as a consequence it had to be worked at a lower suction pressure. This corresponded to the suction pressure required to get the desired results from the refrigerator in the kitchen, and it steadied the operation of the system.

The Engineer Predicted Failure

When started up after making the changes, the engineer predicted all kinds of dire failures when the suction pressure was worked up to about 40 lb. I first started with only the water cooler connected and the whole coil working. When the water temperature came down to 45 deg., I cut in the pantry refrigerator and opened the bypass to the suction on the water-cooling coil. After playing with the outfit for about a day, I found that the water temperature could be held between 35 and 40 deg. most of the time and the refrigerator temperature about the same with the machine running moderately fast and carrying a suction pressure of 40 to 45 pounds.

It took some pretty hard explaining before I was able to show the engineer the relation between compressor capacity, coil capacity and suction pressure. The lower the suction pressure the lower will be the compressor capacity, the capacity varying practically as the absolute pressure. In other words, a compressor working at zero pressure has about half the capacity of one working at 15 lb. pressure. On the other hand, the coil capacity falls off as the suction pressure increases, because with an increase of pressure the temperature of the boiling ammonia increases and the temperature difference between the ammonia on the inside and the medium to be cooled on the outside becomes less and the heat-transfer rate will be slower. If the suction pressure is increased to the point where the boiling temperature of the ammonia is the same as the air or other substance on the outside of the coil, there will be no heat transfer and no work will be done by the coil. This happens when a heavy high-temperature load is suddenly thrown on a system where there are a few low-temperature coils connected. The suction pressure takes a jump and often high enough to stop the heat transfer in the low-temperature coils, the liquid working back to the compressor, starting trouble.

There are to be installed in Glasgow, Scotland, by the Glasgow Corporation, mercury arc rectifiers that have ratings of 170, 330 and 660 hp. The rectifiers are to be used for supplying direct current from an alternating-current supply for light and power purposes. Instead of the glass bulb commonly used in this type of equipment, a steel cylinder insulated on the inside is employed.

Fluctuations in Coal Production—Their Extent and Causes*

By GEORGE OTIS SMITH† and F. G. TRYON‡

AN ELECTRICAL engineer has supplied us with the phrase that best expresses what's wrong with our coal industry—it is the "bad load factor." Whether we refer to full rated capacity or to average output, the operation of the soft-coal mines of the country from year to year, from month to month, and from day to day presents a load factor that has been too wasteful of plant and labor and too productive of high costs and uncertain supply.

The fluctuations in coal production can be regarded as annual, which in a large way reflect nation-wide business conditions; as seasonal, which express conditions of market and distribution; and as daily, which express conditions of labor and car supply. In Fig. 1, the facts of coal production, labor supply, mine capacity and average return to the industry per ton produced, are set forth in curves for the 30-year period 1890-1919. At the base of the diagram is a graphic statement of lost time in mine operation, which is the measure of

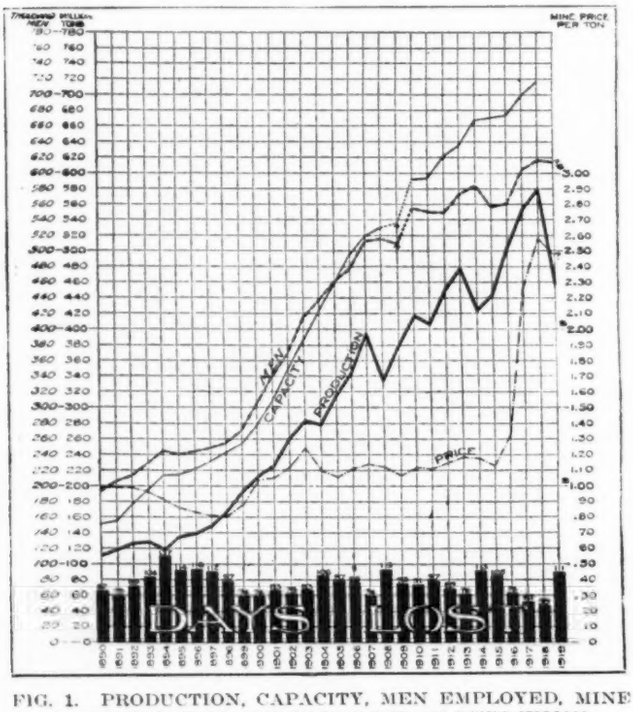


FIG. 1. PRODUCTION, CAPACITY, MEN EMPLOYED, MINE PRICE PER TON AND DAYS LOST AT BITUMINOUS COAL MINES, 1890-1919

wasted opportunity for the economic use of both plant and labor.

The statistics thus presented are weighted averages for the industry spread over the country and carried on under conditions that are widely divergent from place to place.

Mine capacity is seen to have kept well in advance of output, and this capacity curve, so far above even the emergency output of the war period, suggests strongly that the industry has become overequipped and overmanned.

The blocks at the base of the diagram, representing lost time in the soft-coal industry, show that in only seven of these 30 years was such lost time less than 25 per cent of the working year. During this period, out of 308 possible working days a year, mines were idle on the average 93 days. Ten times during that period the time lost exceeded 100 working days. The smallest

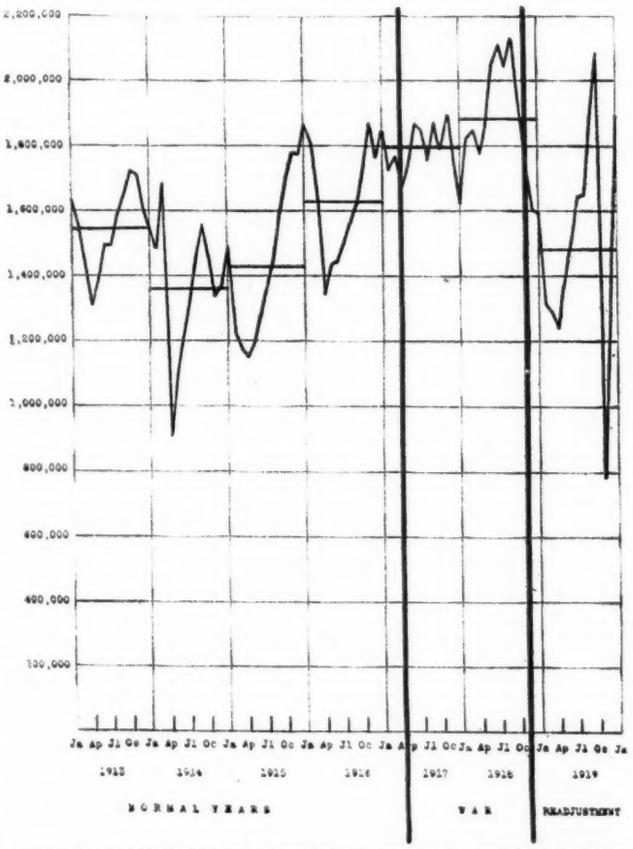


FIG. 2. MONTHLY FLUCTUATION IN COAL PRODUCTION

loss occurred in 1918, the year of record production, yet even during that year the mines were closed down for nearly one-fifth of the time. These figures for lost time, remember, show only the days that the mines were not operated, but absenteeism of a part of the force when the mines were running still further reduced the output. That is, they show only the average opportunity offered to labor by the mines, not the extent to which the individual miner took advantage of his opportunity.

From a study of the diagram the conclusion seems justified that losses above 78 or 80 days are the measure of the effects of annual fluctuations, and that losses below this figure are attributal to season and daily losses.

The annual as distinct from seasonal fluctuation is not confined to the coal industry, and no help can be found for it short of doing away with business cycles of good and bad years.

*Abstract of paper presented at the February, 1920, meeting of the American Institute of Mining and Metallurgical Engineers.

†Director, United States Geological Survey.

‡With the United States Geological Survey.

There remains, however, that residue of lost time from which no normal year is free, and light on its causes must be sought in the study of seasonal fluctuations. To help in this study Fig. 2 has been prepared, on which the annual averages are shown by the heavy horizontal lines and the monthly fluctuations by the broken line. The two pre-war years 1913 and 1914 are typical. The greatest extremes shown in the diagram for normal years occurred in 1914, when the rate of production rose in March to 123 per cent and fell precipi-

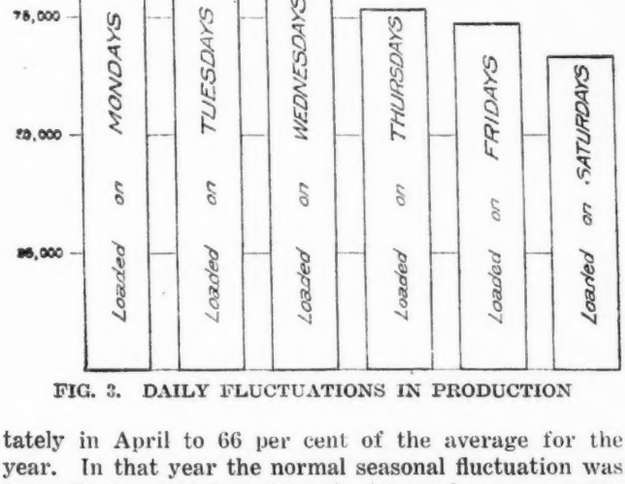


FIG. 3. DAILY FLUCTUATIONS IN PRODUCTION

tately in April to 66 per cent of the average for the year. In that year the normal seasonal fluctuation was intensified and distorted by the biennial wage negotiations. In one respect, however, 1914 was not typical. The autumn peak came in September and was followed, in the last quarter of the year, by a depression which marks the effect of the outbreak of the European war. In other years the peak was reached in November.

The year 1913 may be accepted as a fair type of the odd year, when monthly fluctuations represent seasonal fluctuations in demand only, uninfluenced by labor disturbances. In such a typical year the capacity required during the month of maximum demand will be from 35 to 40 per cent greater than in the month of minimum demand.

To put it another way, even in years of active demand the present inequalities in the summer and winter buying of coal render inevitable a long period in which the labor and capital engaged in the industry cannot work more than 27 to 30 hours out of a 48-hour week. Let no one regard this as a condition to be accepted as the measure of working time necessary to meet demand. As a matter of fact the 30-hour week is the spring ailment of the bituminous-coal industry, not its cure.

In addition to the annual and seasonal fluctuations in production, a third set of fluctuations is exemplified in Fig. 3. The railroad works seven days a week; the mines work six days. Over Sunday the carrier catches up in its work of placing cars, and in consequence the car supply on Monday is by far the best of the week. As a result the miners work longest on Monday, but later in the week their hours of labor show a gradual decline, which is accentuated on Saturday by holiday absenteeism. Even if the mines should attain full time on Monday, they could not under the circumstances expect to work more than 86 per cent of the time on Friday and 79 per cent on Saturday.

The data on seasonal fluctuations so far presented apply to the country as a whole. The typical curve of production for the United States is in fact a composite of a large number of other curves, which differ widely from field to field.

A further contrast distinguishes the union from the nonunion fields. Illinois and much of the northern Appalachian region shows, in the even years, a profound drop in April, which marks the biennial wage negotiations. The slump is regularly preceded by a period of active buying, which often makes the March production the highest of the year. This effect is largely absent from the curves of the middle Appalachian region, which includes for the most part nonunion mines.

Another notable fact is the manner in which the fluctuations for different regions tend to neutralize one another. The demand in the regions served by the Chesapeake & Ohio and Norfolk & Western Railroads, for example, starts upward in February and March, at the very season when the Illinois demand has begun its dive downward. Combining the two gives a much flatter curve than either exhibits alone. The average for the country thus does not at all reveal the full extent of the disease from which the industry suffers. We have merely charted the average temperature of a number of patients in which the severe chill of one patient is offset by the high fever of another. This all-country curve seems discouraging enough, but it is a fact which conceals much local trouble, and any remedy must be applied in terms of local, not national, fluctuations.

The shape of the middle Appalachian curve is determined largely by the movement of coal to the Lakes for consumption in the Northwest. The Lake movement has as its limits April 15 and Dec. 1, and this necessity

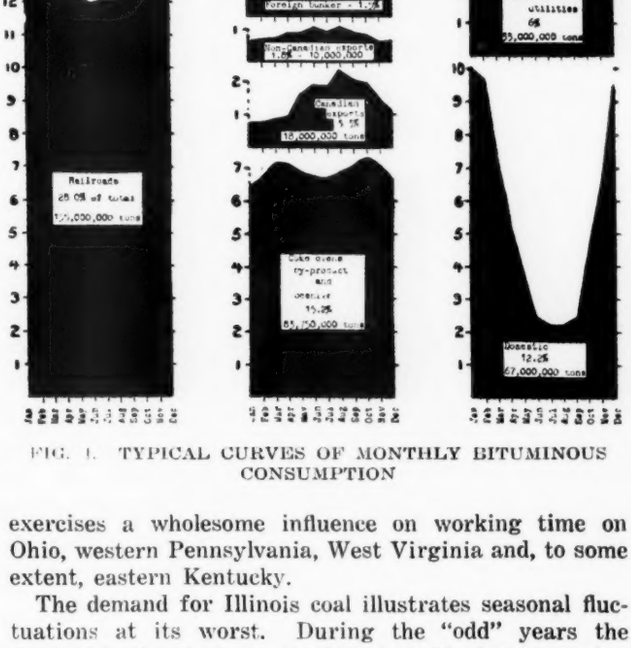


FIG. 4. TYPICAL CURVES OF MONTHLY BITUMINOUS CONSUMPTION

exercises a wholesome influence on working time on Ohio, western Pennsylvania, West Virginia and, to some extent, eastern Kentucky.

The demand for Illinois coal illustrates seasonal fluctuations at its worst. During the "odd" years the demand in the slack month sinks to half what it reaches at the peak, and during the "even" years the production in April approaches zero. The causes of the summer slump are twofold. First the natural market for Illinois coals, as limited by transportation costs, is one in which domestic consumers rely largely on bituminous coal, and of all classes of demand that of domestic consumers fluctuates most with the seasons. In that market,

unfortunately, the steadying effects of the Lake and New England movements and of overseas exports do not enter. In the second place, Illinois coals do not store easily, and up to the present time they have not found favor with coke makers and therefore do not feel the steadying influence of the demand for coke.

It is perhaps significant that there is a rough relation between the loss of working time and the degree of unionization. Those bituminous regions in which interruptions to operation are most pronounced show a tendency to become union territory. The presence of the

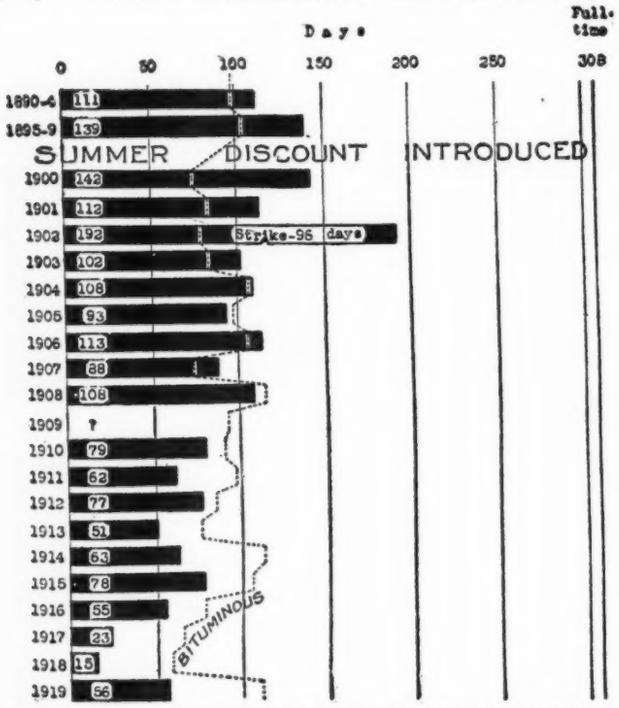


FIG. 5. DAYS LOST IN ANTHRACITE MINING BEFORE AND AFTER THE INTRODUCTION OF SUMMER DISCOUNT

union is both cause and effect. Wage disputes cause lost time; but, on the other hand, irregular employment is in itself a prime incentive to unionization.

The fact of irregularity in working time is thus indisputable, and its extent is shown to be everywhere great, and everywhere it reacts favorably upon all who have a share in producing soft coal and all who have a share in consuming it. In long periods of idleness following a business depression it drives the miner to seek employment in other industries. The fact that we find the same large labor turnover in other industries should not blind us to the fact that these are causes as well as symptoms of industrial unrest. The question may even be raised whether irregular employment is not largely responsible for the failure of coal miners to take full advantage of the opportunity to work when the mines are open.

The case of the miner against irregular operation has already been forcibly set before the public. What is not so generally realized is that the case of the operator is just as damaging to him. His capital is idle, and his mine is raidly depreciating. Although the mine shuts down, his fixed charges run on—not only interest charges and salaries, but a host of maintenance charges as well. And in the end the coal consumer pays the bill for idleness of miner and mine.

The effects of fluctuation in coal production on our transportation system can readily be appreciated. The coal mine is the railroad's largest shipper, and the railroad in turn is the largest consumer of coal; in fact it has been remarked that coal is the nucleus around which our railroad system is built. The railroad suffers from the seasonal fluctuations in coal production as well as the coal-mining industry, for it meets the same seasonal demand. Equipment sufficient to transport all the coal that the mines can produce in November would in large part lie idle during the slack season of summer. The capital investment in coal-carrying equipment alone is of the same order of magnitude as the capital investment in coal mining, and it is no less desirable to provide constant employment for the railroad capital than for the mine capital.

A complete analysis of the effects of the irregular operation of the coal mines would include references to the coal dealers, both wholesale and retail, but the consumer is, of course, the one whose purse suffers most, for in the long run he pays for all the wasteful practices. He must support the miner for not only the 215 days that coal is coming from the mines, but also for the 93 possible working days when the mines are closed.

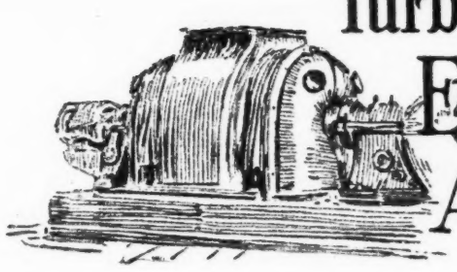
An attempt to study the degree to which different consumers affect the seasonal market yielded the group of consumption curves given in Fig. 4; the values in this diagram are only tentative and are subject to sweeping revisions. The seasonal fluctuation in locomotive consumption is seen to be a factor, for the railroads consume 28 per cent of all soft coal mined. An even larger offender in degree is the domestic consumer, although the amount involved is much smaller. The general industrial user doubtless ranks next as a contributor to the seasonal fluctuations, but the public utilities present a much more even curve, and the curve for the iron industry is somewhat the same. Fortunately, certain other industries, export and bunker trade and the Lake shipments tend to smooth out the seasonal curve.

The problem of improving the load factor for the coal mines thus becomes a problem of encouraging the summer buying of coal. Two methods of solving this problem have been suggested—seasonal discounts of the coal price and seasonal freight rates. Fig. 5 presents a comparison of lost time in the anthracite and bituminous mines since the summer discount was introduced for anthracite. It will be noticed that the present advantage of the anthracite mines did not immediately follow the new system—the consumer has to be educated even to serve his own interests. A seasonal discount in freight rate seems wholly justified by the railroad's interest in its own load factor; it, too, can afford to bid for summer traffic in preference to the more expensive winter haul.

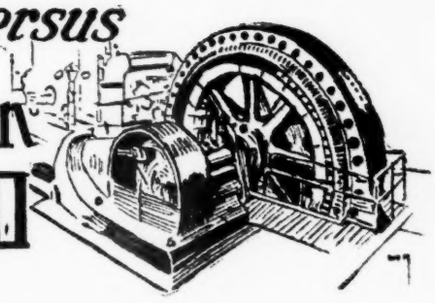
The general interest of our whole nation in bettering the load factor of the soft-coal industry is large. Society cannot view with equantity the spectacle of an excess mine capacity of 150,000,000 to 200,000,000 tons, and an excess labor force of perhaps 150,000 men.

High wages, due to the war, and steadily increasing demands for labor which cannot be supplied are the two outstanding reasons for soaring prices according to Calvert Townly, President of the A. I. E. E. at a recent address before a meeting of the Schenectady section of the Institute.

As soon as European indusries begin to function properly and the demands of commerce again become normal, American will cease to supply a large share of the world with necessities, the labor situation will adjust itself and prices will drop.



Turbine-Driven *versus* Engine-Driven Alternators - II



By S. H. Mortensen*

Features of stator construction and generator operation are compared, covering insulation, operating temperatures, voltage regulation, synchronizing, parallel operation and other operating features.

THE stator of an engine-type alternator consists of the laminated iron core, the stator coils and the supporting structure, which is called the yoke. The core is built from a number of thin iron stampings or punchings located inside the yoke and carrying the stator coils in slots in their inner cylindrical surface. Fig. 1 shows the longitudinal section of an engine-type alternator. The stator-core punchings *R* are dovetailed into grooves in the yoke *Y* and are securely held between clamping plates *C*. The core is subdivided by means of spacers or ventilating segments, which allow the air currents set up by the rotation of the rotor to pass through the core iron and escape through holes *H* in the yoke. In addition to carrying the weight of the stator punchings and coils, the yoke has to have sufficient stiffness to resist the magnetic pull to which it becomes subjected when the rotor gets out of the bore center. The stator coils are held in the slots by means of wedges fitted into grooves in the core iron. The projecting parts of the coils are protected against mechanical damage by means of shields bolted to the yoke casting. Openings in the shields permit the ventilating air to escape after sweeping over the coil ends. The free ends *E* of the stator coils seldom extend far enough beyond the core iron on machines of this type to require a special support, and in extreme cases it is generally sufficient to interlace the coil ends to enable them to withstand the shocks due to short-circuits on the armature or chafing due to vibration.

In engine-type alternators the coils are protected generally by A. I. E. E. class "A" insulation made from cellulose materials, such as treated cotton tape, paper and similar materials. This insulation will withstand continuously a temperature of 105 deg. C. (221 deg. F.) without losing its insulating qualities or becoming brittle. It is to be distinguished from class "B" insulation made from materials such as micanite, asbestos, etc., which can be operated continuously at temperatures from 125 to 150 deg. C. (257 to 302 deg. F.) without deteriorating.

Experience has shown that the durability of the insulation is not increased by operating it at temperatures below the maximum permissible values already stated, but if the temperature in any part of the coil exceeds 105 deg. C. (221 deg. F.) for class "A" insulation, it will carbonize rapidly, become brittle and suffer permanent damage, the extent of the deterioration depending upon the length of time and the excess of temperature to which the insulation is subjected.

As the life of a machine depends upon its maximum operating temperature, it is important to determine this temperature with as great accuracy as possible. A number of methods are in use, but for a machine whose diameter is large as compared with its length and whose parts are accessible, the thermometer method is generally applied. Such measurements, however, give only approximate results, as the maximum coil temperature

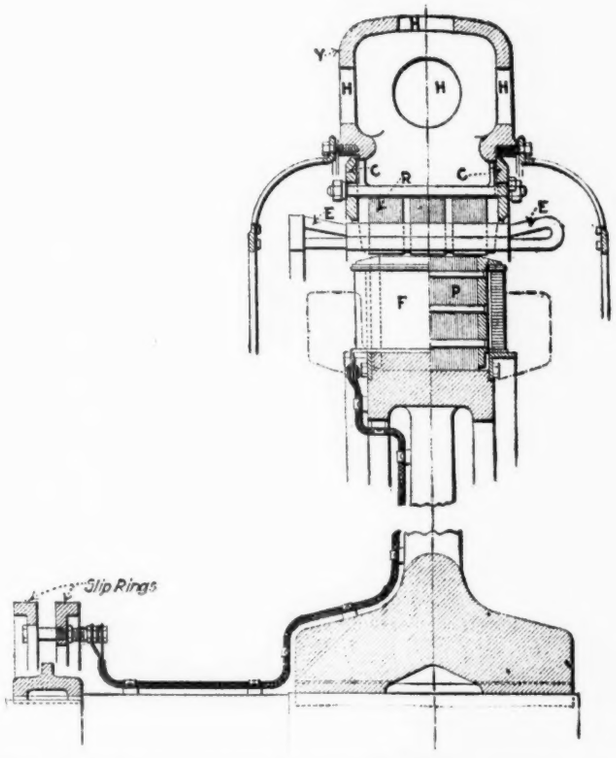


FIG. 1. SECTION THROUGH ENGINE-TYPE ALTERNATOR

is found inside the insulation, which, of course, is inaccessible. To offset this discrepancy, it is customary to add a corrective factor to the observable temperature, which approximates the difference between the temperature measured on the outside of the coil and the temperature on the inside of the coil. According to the rules of the Standardization Committee of the A. I. E. E., this factor is 15 deg. C., or 27 deg. F., if the temperature is determined by thermometer. With 105 deg. C. (221 deg. F.) as a maximum safe operating temperature and a corrective factor of 15 deg. C., the maximum observable temperature of the stator coil is 105 — 15 = 90 deg. C., or 194 deg. F.

*Electrical Engineer, Allis-Chalmers Manufacturing Company.

As a standard for the air temperature upon which the rating of electrical machines is based, the American Institute of Electrical Engineers prescribes 40 deg. C. (105 deg. F.), and this then limits the maximum temperature rise for a class "A" insulated coil to 50 deg. C., or 90 deg. F. This rule does not apply to field coils wound of copper strip, such as were shown in Fig. 4 of

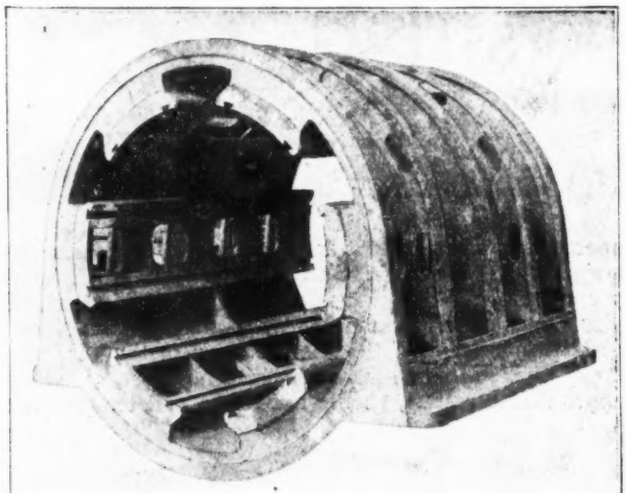


FIG. 2. STATOR YOKE OF TURBO-ALTERNATOR

the preceding article dealing with the rotor, Mar. 2 issue. For this kind of coil, where the thermometer can be placed directly on the copper, the corrective factor, according to the rules of American Institute of Electrical Engineers, is 5 deg. C. This permits a maximum observable temperature of 100 deg. C. (212 deg. F.) or a temperature rise of 60 deg. C., or 108 deg. F., based on 40-deg. C. (104 deg. F.) air, for a class "A" insulated field coil. It is frequently more convenient to determine the temperature of the field winding by its rise in resistance, and to the value thus obtained a corrective factor of 10 deg. C., or 18 deg. F., is to be added to attain the maximum coil temperature. Class "B" insulation is seldom applied on engine-type alternators.

On a turbo-alternator the stator has to meet the same requirements as the stator of an engine-driven machine, but on account of its crowded construction and great width, additional problems have to be met in its design. Figs. 2, 3 and 4 show a turbo-stator in three different stages of completion, and Fig. 5, the finished stator with its end covers. To insure a tight stator core, it is necessary to clamp the core punchings together under great pressure, and the clamping plates and clamping bolts are correspondingly heavy, as may be seen from Fig. 3. Special provisions have to be made to rigidly support the projecting ends of the stator coils so that they will withstand the heavy shocks to which they are subjected should the generator become short-circuited or be thrown in parallel with other machines when out of phase with them. In either case the value of the short-circuit current during the first few cycles may reach from 10 to 40 times the rated generator current, depending on the characteristics of the machine. The duration of this heavy current is instantaneous, and it recedes, within two to three seconds after the short-circuit, to a value that is fixed by the excitation of the machine when the short-circuit occurs. This latter value is generally from 1.2 to 3 times the rated current of the machine.

The peak value of the current is of too short duration to affect the coils by heating, but the magnetic flux that accompanies the current develops attraction or repulsion between the stator coils in the different phases sufficient to twist and bend the parts of the coils not rigidly supported, which means the parts of the coils that are not embedded in the stator slot. For that reason, special provision must be made for bracing and supporting thoroughly the coil ends. In Fig. 4 one method of coil support is shown. Instead of using the bracket support shown, the coil ends may be laced to one or more supporting rings. Relays are not practicable for protecting a machine against the shocks due to short-circuit because they do not act quickly enough. The problem of coil support is particularly difficult in the construction of large 25-cycle machines, and has frequently led to the adoption of reactance coils connected in series with the generator terminals. The function of the reactance coils is to choke down the instantaneous short-circuit current and thereby reduce the shock to which the coils and the machine are subjected.

The electrical operation of engine-driven alternators and turbo-alternators is quite similar. The voltage regulation is accomplished by varying the field strength, either by changing the setting of the main alternator's field rheostat or by altering the exciter voltage. As the energy dissipated in the field rheostat is a total loss, the voltage variation should, wherever possible, be accomplished by changing the exciter voltage.

Of engine-type alternators the voltage regulation, as a rule, is better than with the turbo-alternator. However, the introduction of automatic voltage regulators

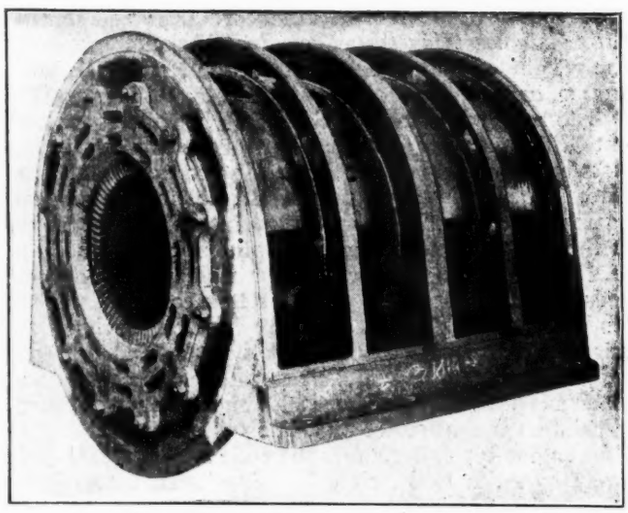


FIG. 3. STATOR YOKE OF TURBO-ALTERNATOR WITH CORE PUNCHINGS CLAMPED IN PLACE

has made this feature one of minor importance. At the present time machines whose voltage regulation from full load to no load is from 40 to 60 per cent are in successful operation.

In synchronizing, the same requirements regarding voltage, frequency and phase relationship are to be met by either type of machine. It is, however, much easier to synchronize turbo-generators with each other or with engine-driven alternators than it is to synchronize engine-type machines with each other. This is due to the uniform speed of the turbo-generator, which permits periods ranging from 1 to 15 seconds for synchronizing. After the machines are operating in parallel, the most

noticeable difference is due to the speed regulation of the respective prime movers. As the steam-turbine regulator can be adjusted to give much closer regulation, the alternator endeavors to take all the load fluctuations on the system. The engine-driven machines will carry a steady load as long as the fluctuations do not exceed the capacity of the turbo-unit; in other words, the turbo-generator functions as a flywheel or a storage battery.

The uniform speed of the turbo-alternator makes it particularly suitable for supplying power to rotary converters or synchronous motors, and the trouble of hunting frequently experienced when machines of these types are supplied with power from engine-driven alternators is practically unknown where turbo-generators are used. The close speed regulation, together with the stabilizing effect of the turbo-unit, makes it a desirable addition to power systems with heavily fluctuating loads where the power is developed by reciprocating engine-driven alternators. On such systems, during the periods of light load the turbo-unit can be adjusted to operate lightly, and during the peaks, with the steam valves fully opened, it will be able to meet the additional power requirements which otherwise would cause appreciable drop in frequency and voltage and interfere with the operation of the synchronous machines on the system. If close speed regulation is not desirable, the regulator on the steam turbine of course can be adjusted for coarser governing.

Between alternators in parallel the load division in kilowatts depends on the power input of the prime movers, but the distribution of the wattless current required by the system between the different machines

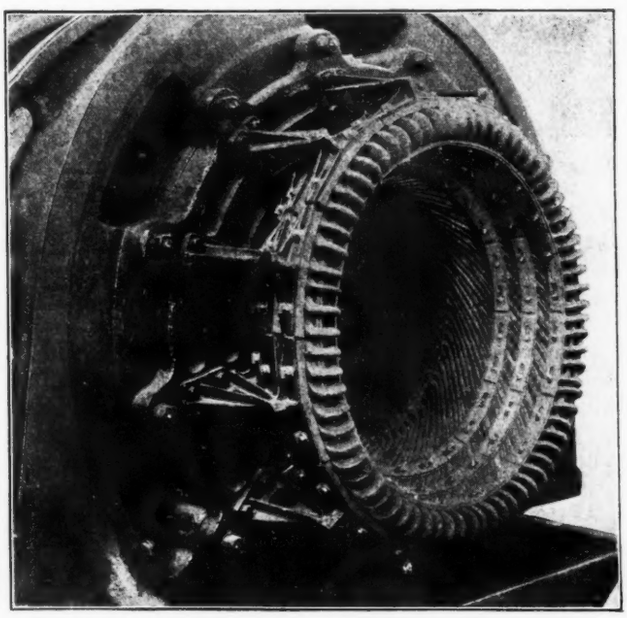


FIG. 4. BRACKET-TYPE COIL BRACING IN TURBO-ALTERNATOR

is controlled by the field excitation, which is generally adjusted to give each machine its proper share of the wattless current in addition to its kilowatt load. Under special circumstances it may be desirable to let certain of the units carry the kilowatt load and then supply the wattless current from one or more units by overexciting their alternators. The turbo-driven alternator is particularly suitable for this class of service. It is started and synchronized in the usual manner, but after it is in parallel its excitation is increased until its current is limited either through the rotor or stator heating. At the same time the steam admitted to the turbine can be reduced until the amount is just sufficient to carry off the heat that is generated by the friction between the turbine blading and the surrounding steam. If no provisions are made for this purpose, the blading will overheat and suffer permanent damage and finally break off. If the amount of steam admitted is not sufficient to supply the losses in the unit, the generator will draw the balance of the power required from the system, and operate as an overexcited synchronous motor (synchronous condenser). The power required to drive a

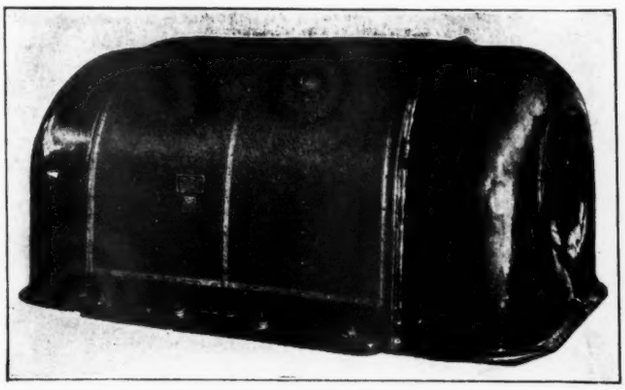


FIG. 5. STATOR OF TURBO-ALTERNATOR COMPLETE WITH END COVERS IN PLACE

turbo-alternator under this condition is small, and as its characteristics are such as to exclude the danger of hunting, this method of operation can be counted upon to give satisfactory results. Engine-driven alternators are less suitable for power-factor correction, as they require a considerable amount of power and are likely to hunt and cause disturbances.

In the foregoing a few of the salient points in construction and operation of engine-type and turbo-alternators have been covered. In conclusion it can be said that the operation, higher efficiency, small space required, etc., of the turbo-unit gives this type of machine an advantage so decided as to lead to its replacing the reciprocating unit except in the special cases where cheap gas or oil warrants the installation of the engine-type alternator.

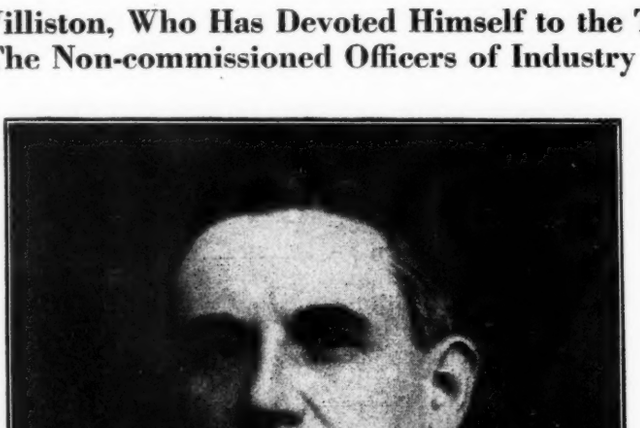
In the course of the excavations for the new Welland Ship Canal, near Thorold, in Southern Ontario, the site of an immense prehistoric waterfall has been uncovered. The Chicago *Evening Post* says that the edge of the fall has been disclosed for a distance of 400 ft., but the depth has not been ascertained. Above the main fall there are indications of a series of lesser falls, with a total drop of 25 ft., which are plainly water-worn. The site is about half a mile from the present Falls of Niagara, and it is believed that the deep canyon-like valley through which the ship canal passes, where Eight Mile Creek once meandered on its way to Lake Ontario, must have been the bed of the prehistoric river which furnished the waters of the giant falls with their outlet to the sea.

There is a gold mine in Ouray County, Colorado, where the whole of its plant, including everything from the crushing mill to the settling tanks, is built in underground chambers. This is because of the severity of the snow slides, which wreck all buildings above the ground level.

An Advocate of the Junior Technical School

Arthur L. Williston, Who Has Devoted Himself to the Training of The Non-commissioned Officers of Industry

DURING the past half century, a great deal has been said and written about technical engineering education. Beginning with a few pioneers, the idea of technical training has swept over the whole country, until, now, a college or university seems incomplete if it does not have one, or more, engineering courses. No one now questions the fact that the technical men, trained in the engineering schools and universities, have played an important and essential part in the world's industrial progress. There is another field, however, which has attracted comparatively little attention, but which at last seems to be coming into its own. This is the field of technical education as represented by the trade schools, or those schools which do not go into the highly specialized technical work as is done in the colleges and higher schools of technology.



ARTHUR L. WILLISTON

One of the men most prominently identified with this work is Arthur L. Williston, principal of the Wentworth Institute in Boston. Mr. Williston is a real enthusiast when it comes to this type of industrial education. He was born October 18, 1868, in Cambridge, Mass., and comes from a family of educators, both his father and grandfather being engaged in this work. The latter, Mr. Samuel Williston, was the Founder of the Williston Seminary at Easthampton, Massachusetts.

After graduating from the Massachusetts Institute of Technology in 1889, Mr. Williston spent a year at graduate work in the Institute, and then worked on railroad construction, in Oregon and Washington, for the Union Pacific Railway. In 1891, he had his first experience in teaching as an instructor in steam engineering at Technology, but the next year we find him back in railroad work, in charge of bridges over about 6,000 miles of road for the Big Four Railway.

In 1893, he came back to Boston as a mechanical engineer with Lockwood, Green Company, but that fall went to Columbus, Ohio, and became Professor of Mechanical Engineering at the Ohio State University. While here, Professor Williston was also secretary of the Engineering Faculty of the University. After five years in Ohio, he was made director of the School of Science and Industry at Pratt Institute, Brooklyn, New York. Here began, what Mr. Williston describes as his life work, "in the pioneer field of creating a new type of technical education."

Arioch Wentworth, a citizen of Boston, expressed in his will an aim to establish a school "for the purpose of furnishing education in the mechanical arts." As a result, there was incorporated, under the laws of Massachusetts, the Wentworth Institute, which should be a school such as Mr. Wentworth described. In 1910, when the physical plant of the school was only represented by architect's drawings, the trustees chose Mr. Williston as principal. Under his direction, the school was organized and the buildings erected, and the Wentworth Institute has become a prominent factor in its particular field of education. The old system of apprenticeship education in the mechanical trades had much to recommend it and much to condemn it. Under a competent journeyman who is willing to help, the apprentice could become in time, a real workman. An incompetent master, or one who, however competent in his trade, could not teach another, resulted in much waste of time for the apprentice. Whatever its faults or virtues, the apprentice system has practically disappeared from modern industry. The only substitute for it is the trade school, or the junior technical school.

As Mr. Williston sees it, such a school should cultivate intelligence as well as manual skill. It should develop habits of reasoning, initiative and ambition. Enough instruction and practice should be allowed for the student to acquire a reasonable degree of skill in the use of his tools and material, but he must also receive instruction in the technical and scientific principles covering his work. Only when he has received a sound fundamental training in the technical principles of his trade, can a workman do things intelligently, otherwise he must blindly follow the habits and customs of that particular trade. In the trade school, however, great care is necessary not to emphasize the technical side of the training too strongly. The man who wants a highly specialized training goes to the technical school for it, not to the trade school, and the man who goes to the trade school desires especially practical instruction in the operation of that particular trade.

A system of education based on these principles has been Mr. Williston's dream for a number of years. His nine years of varied engineering experience and his twelve years in the Pratt Institute, in addition to his thorough technical training, gave him an excellent foundation for the practical development of this dream when the opportunity arose. As the active head of the Wentworth Institute from its beginning, Mr. Williston has had an excellent opportunity to convert his ideas into practical results. Whatever measure of success the Institute has achieved, must be credited, to a very large extent, to him. That the school has been a success is testified by the fact that the War Department established one of its schools for engineering troops there during the war. This was not a unit of the students' army training corps, but a school for the special training of a number of the engineering corps for their particular duty.

Enthusiastic as Mr. Williston is over the Wentworth Institute, he finds time for considerable work on the outside in the same direction. He is a member of the American Society of Mechanical Engineers, and the Society for the Promotion of Engineering Education, of which he is secretary and vice-president, and of the National Society for the Promotion of Engineering Education, of which he is a director, and also a secretary of the State branch. He is also president of the Industrial Educators Department and of the Science Department of the National Educational Association. In addition to the active part that he has taken in the work of these societies Mr. Williston, himself, has made surveys and investigations along the lines of industrial education for a number of important educational institutions throughout the country. During the war he was Educational Director for New England for the War Department Committee on Education and Special Training.

Hot-Process Water Softening

The hot-process water softening system is the result of an effort to take advantage of the increased rapidity of chemical reactions in hot water. The curves in Fig. 1 are from the results of tests made in the chemical laboratory of the Harrison Safety Boiler Works to determine the effect of temperature on the reactions taking place in the treatment of boiler feed water.

It will be seen from these curves that the reduction in calcium and magnesium salts is greater at the end of ten minutes in water at 210 deg. F. than at the end of five hours in water at 50 deg. F. In fact, twenty-four hours in cold water did not bring down as much scale forming matter as ten minutes in hot water. The sample which had stood for five hours at 50 deg. F. was then heated to the boiling point with about the same result as ten minutes' treatment in hot water.

The effect of hot water may be shown roughly by the following simple experiment. Place one pint of cold untreated water in each of two beakers, heat one sample to the boiling point and add the theoretical amount of water softening chemical to each sample. Stir thoroughly and note the result. The reaction and sedimentation will be much more prompt in the hot water.

When the reaction seems complete in the cold water, carefully pour off the clear liquid and heat it to the boiling point. Further precipitation will result, showing that the reaction was incomplete in cold water.

Another advantage of the hot process is in the increased velocity with which the particles of solid matter settle to the bottom of the liquid. From Sokes' law, the velocity with which a spherical particle will sink in a liquid is given by the following:

$$V = \frac{2}{9} \times \frac{D - d}{N} \times gr^2$$

where V is the velocity, D the density of the particle, d the density of the liquid, g the acceleration due to gravity, r the radius of the particle, and N the coefficient of viscosity of the liquid.

It is obvious from this formula that the smaller the coefficient of viscosity, the faster the particles will sink to the bottom. The accompanying table gives some

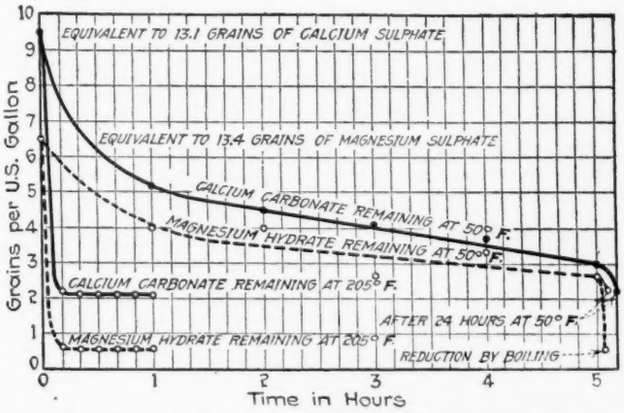


FIG. 1. EFFECT OF TEMPERATURE ON WATER SOFTENING REACTIONS

values of this coefficient of viscosity for water at different temperatures. From these values it may be seen that a given particle of solid matter will settle about four times as fast in water at 212 deg. F as in water at 68 deg. F.

Consider the effect of this fact in a tank of quiet water. A particle of a given size will fall four times as far in hot water during a given time as in cold water. In the case of a continuous water softener the velocity of flow through the sedimentation tank may be four times as much with hot water as with cold water, without carrying particles of a given size to the pump supply. It will be noticed further from the formula that the sinking velocity of a particle varies as the square of its radius. Therefore it is obvious that much smaller particles will have time to settle out in hot than in cold water if we keep the velocity of the water through the settling tank constant.

In any water softening apparatus it is necessary that the chemical reagents be supplied at a rate which is proportional to that at which the raw water enters the system. Many mechanical devices have been used to control the reagent supply. In some of these the raw water flowing to the softener turns a waterwheel or operates a tilting bucket which in turn operates dippers by which the reagents are ladled out. In other softeners a certain portion of the water, divided from the main supply by weirs or orifices, is led through chambers containing the reagents. In another form the water displaces the reagent from a tank, at the same time diluting the remaining reagent, this dilution being compensated for by adjusting the orifices.

The hot-process softener should carry a few pounds pressure so as to insure a temperature of at least 205 deg. F at all times. Under these conditions the methods

of proportioning referred to are not entirely satisfactory. One method applicable to the hot-process is to drive a pump, supplying the reagent, by means of the raw water. Of course in this case both the water motor and the pump must be kept in first class condition to avoid poor proportions due to leakage.

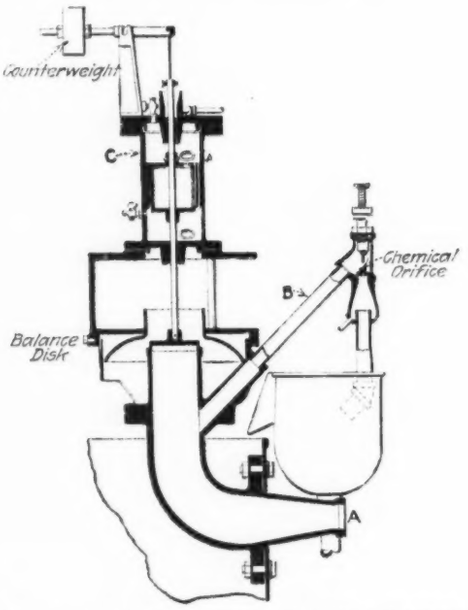


FIG. 2. REAGENT PROPORTIONING DEVICE

Another reagent proportioning device depends upon the difference in pressure on the two sides of an orifice through which the raw water flows. A diagram of this apparatus is shown in Fig. 2. The raw water flows through an orifice (not shown) on its way to the softener. Pipes are led from above and below this orifice to the top and bottom respectively of the cylinder *C*. The differential pressure on the orifice then tends to lower the piston. The chemical reagent enters at *A* under pressure and a part goes up through the pipe *B* to the *chemical orifice*. The remainder of the reagent flows out under the valve or *balance disk* which is held down by the piston referred to above. Thus the pressure on the reagent orifice is always equal to the differential on the raw water orifice and the amount of reagent fed is always proportional to the amount of raw water. The reagent which flows out at the balance disk is returned to the reagent storage tank and pumped into the apparatus again. The chemical passing the orifice is caught in the funnel shown and drains from there to the chemical feed pump which forces it into the softener against whatever pressure is maintained. The counter weight balances the weight of the piston and valve disks.

Feed Water in Contact With Steam

The hot-process apparatus should consist of an open type feed water heater, where the feed water is heated by direct contact with the steam. As the heating takes place the dissolved gases will be given off and then the chemical reagent should be mixed with the water. The water then should move slowly downward to allow settling of the precipitate and be drawn off near the bottom of the tank. By admitting the water at high temperature at the top of the tank and causing a slow downward circulation, no convection currents are present to stir up the mass of precipitate.

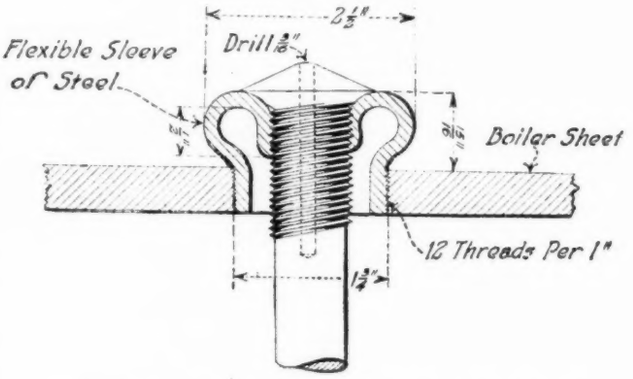
Some conditions require the use of sand filters after the chemical treatment. These are simply beds of sand through which the water flows by gravity. These filters are cleaned by reversing the direction of the water flow, "back washing," and at the same time blowing air through orifices embedded in the sand bed.

TABLE BY THORPE AND RODGER SHOWING VARIATION IN VISCOSITY OF WATER WITH TEMPERATURE

Temperature Degrees F.	Co-efficient of Viscosity
32	.01775
50	.01303
65	.01002
86	.00798
104	.00654
122	.00548
140	.00468
158	.00406
176	.00356
194	.00316
212	.00283

Gallagher Flexible Staybolt

One of the chief troubles incidental to the use of staybolts between flat surfaces arises from the unequal expansion of the two sheets. One is usually in contact with the fire, and the other is heated to the temperature of the water. This difference in temperature causes considerable relative motion between the two sheets, which frequently results in broken staybolts in a section near the inner surface of the sheet.



STAYBOLT AND FLEXIBLE SLEEVE APPLIED TO BOILER SHEET

The old non-flexible staybolt is especially susceptible to rupture, and, as a result, several forms of flexible staybolts have been used with success. A recent form of flexible staybolt is the invention of P. F. Gallagher, Clifton, S. I. It consists of a flexible steel sleeve $2\frac{1}{2}$ in. at the largest outside diameter. This sleeve is threaded to screw into a $1\frac{1}{4}$ in. tapped hole in the boiler sheet, and is also threaded 12 threads per inch to take a 1 in. dia. drilled staybolt at the threaded portion. The end of the staybolt is riveted over as shown in the illustration. The flexible sleeve extends $\frac{15}{16}$ in. beyond the boiler sheet on the outside, and is $\frac{3}{16}$ in. thick. This allows of a staybolt 1 in. longer than could be used if the staybolt were screwed directly into the boiler sheet. The idea of this design of staybolt is to obtain flexibility in the steel sleeve, instead of having the strain, due to unequal expansion of the plates, come directly on the staybolt next to the boiler sheet.

EDITORIALS

Fluctuations in Bituminous Coal Production

IN THIS issue appears an abstract of the paper presented by George Otis Smith, Director of the United States Geological Survey, before the American Institute of Mining and Metallurgical Engineers. It gives statistics from the Survey's data regarding the irregularity of coal production and shows how serious is the situation. When an industry as important to the welfare of the country as this one is shut down an average of 93 out of 308 working days per year, the public ought to know the reasons. If the causes contributing to this condition can be removed, no time should be lost in doing so.

The immediate causes of seasonal fluctuations are car shortage, labor shortage, mine disability and "no market." A study of such figures as are available shows that by far the major portion is credited to car shortage in the winter months and "no market" in the spring months. For example, in April, 1919, the time lost due to the latter cause averaged over forty per cent of full-time operation. This of course results in a condition of car shortage when the demand rises in the fall and winter months. It is interesting to note that during the period from 1910 to 1918 only 10.6 per cent of the time lost in the bituminous mines was due to strikes.

The measure of responsibility of the domestic consumers for the fluctuation is shown very forcibly in the curves of monthly consumption. Although householders take only twelve per cent of the total production, the fluctuation from about two million tons in July to ten million tons in January is more serious than that due to any other class.

The picture Mr. Smith's paper paints is black, but the reality is worse than may appear from a hurried inspection of the data. The number of "lost days" as given represents only days when the mines are closed, days when no coal can be mined whether the miner wants to work or not. No statistics are given to show how completely the men take advantage of the days when the mines are open. That there must be considerable loss from individual absenteeism is evident. Moreover, the seasonal "slump" in production occurs at different times in different fields. Therefore, in many localities the conditions are much worse than the average curves for the whole country show.

It is pointed out that this condition adversely affects the miner, the operator, the railroad, and the consumer. They all suffer, but as always, the consumer has to pay the bill. The miner has to eat 365 days a year, the operator and railroads have to earn a reasonable return on their capital. If miner, operator and railroad could work continuously, they would receive a bigger return and at the same time the consumer would have cheaper coal.

As was pointed out in these columns last week, the solution of the problem must come, for the most part, from the storage of coal during the summer to help meet the extra winter demand. Furthermore, this storage must be at or near the point of consumption.

There have been several objections raised to the plan of summer storage. One is that an enormous amount of capital would be tied up in coal-storage equipment and in the stored coal. It does cost a lot of money to build a coal-storage plant. It is also true that storage of coal means an extra handling. On the other hand, a few shutdowns of any plant due to inability to get coal would more than make up for the cost. That such shutdowns are likely to occur the experiences of the last few years furnish sufficient evidence.

Another objection to the storage of bituminous coal in large quantities is its tendency to spontaneous combustion. It cannot be denied that this danger is a real one with improperly stored coal. It has been proved, however, that bituminous coal can be stored safely and that it will suffer little or no depreciation if reasonable care is used.

A reduced summer price at the mines and a reduced summer freight rate would undoubtedly lead many consumers to buy coal at the slack season and store it. This would divide the burden more evenly among those who would benefit. There has been a feeling that the coal interests welcomed the annual shortage in winter in order to raise prices, and such a differential rate would help materially to remove this friction. One of the diagrams in Mr. Smith's paper shows how successful this plan has been in the anthracite mines.

Whatever the final result of the various plans may be, it is obvious that the storage of coal in summer by the individual consumer will result in benefit to himself. At the same time he will be doing his part toward the solution of a serious national problem.

Economical Supply of Electric Power

SINCE the introduction of the steam turbine as a successful prime mover, advancement in large power-plant design has been so rapid that one scarcely has had time to recover from amazement at some great achievement in power-plant engineering before another of greater magnitude has been accomplished. In the opinion of many the limit in size of steam-turbo-generator units has been nearly reached; if not from structural limitations, from economical considerations. However, now comes the superpower plan, to provide an economical supply of electric power for the industries and the railroads of the northeast Atlantic seaboard.

This plan, the most stupendous conception in power generation and transmission ever conceived, and some of the engineering problems it involves, were presented at the midwinter convention of the American Institute of Electrical Engineers, in the form of a symposium, by ten of the leading consulting, designing and power-plant engineers and discussed by a number of others. An abstract of this symposium and discussion appears

in this issue. The plan as proposed suggests an electric generation and transmission system running from Boston to Washington, D. C., from which power will be supplied to factories and railroads wherever economically possible in a zone extending from one hundred to one hundred and fifty miles inland from the coast. It is estimated that such a scheme would supply the necessary power from a plant capacity of five and a half million horsepower which at the present time requires seventeen million—ten million for the industries and seven million for the railroads. It is predicted that the load factor, at present not exceeding fifteen per cent, would be raised to more than fifty per cent. As a result there would be an estimated yearly saving of three hundred million dollars and thirty million tons of coal, besides relieving the intolerable congestion of the railroads in this zone. It will also make possible the economical development of many of the water powers within this zone that cannot be utilized economically under the present system. Whether this plan or some other is the solution of the power and transportation problem along our northeastern seaboard, it is apparent that a very serious condition exists in that zone as was emphasized by harassing experiences during the war.

The first logical step in such an undertaking is a complete survey by a representative commission of engineers. An appropriation by Congress to make the necessary investigation under the direction of the Department of the Interior, as has been requested, would be a step far reaching in the solution. There is little doubt that this system will consist of a tieing together of the large generating systems in the large industrial centers reinforced by water-power plants on the rivers and steam-power plants at the mines. Consequently, before anything constructive can be done it must be definitely known just what the essential features of this development will be and if the scheme suggested is economically correct. If this system is going to operate at sixty cycles and it becomes definitely known that this is to be the standard frequency, then it will be a matter for the various power companies in this zone standardizing as far as economically possible on this frequency, so that when the time comes for tieing all the large systems within this zone together, one of the most important features in regard to interconnection will be in a fair way to being solved. Prof. Malcom Maclaren, in discussing this problem, said:

"The picture, which might be formed of a general scheme to be followed during the next ten years to meet the growing need for power within this territory, is that the power companies in the large cities should in general complete their present construction programs but should not greatly increase their generating facilities beyond this point, additional capacity being obtained by the construction of steam plants at the mines, reinforced on the east by hydro-electric plants on the Delaware River and on the west by hydro-electric plants on the Susquehanna, the whole territory being interconnected with transmission circuits. Such a system should procure a cheap and reliable source of power under normal conditions and would have the greatest flexibility for meeting emergencies, for the generating facilities would be divided in approximately equal amounts among steam plants at the large cities burning bituminous coal, steam plants at the mines burning anthracite and hydroelectric plants on the Delaware and Susquehanna Rivers; the unified system of transmission circuits making it possible to transfer larger blocks of power to any point in distress without the use of rail transportation."

The foregoing apparently is one of the most logical schemes, since on account of certain physical problems there is little doubt that a large percentage of the power generated from coal in this zone must be produced locally near the large industrial centers, as at present.

Oil Land Leasing Bill a Law

PRESIDENT WILSON has signed the bill releasing for development millions of acres of Government oil, coal and phosphate lands in the West. California and Wyoming lead in the extent and richness of their deposits, although Louisiana, Arizona, Utah, Wyoming, Colorado and Alaska are represented in the oil field. In coal lands North Dakota leads the other twelve States with more than eleven million acres.

The bill provides for a royalty rental on the fuel produced, and in the case of oil this may be demanded in oil or in cash as the Government elects. This year, at least, the Government is expected to collect its royalties in oil so as to assure a supply for the Shipping Board at fair prices. The naval reserve oil lands are not to be opened unless the President shall so prescribe. That these lands will be promptly developed is evident from further reports that there were "rushes" to file location claims in a number of the fields. As most of these oil lands are in the fields producing fuel oils, this development will be of interest to all fuel-oil consumers. There has been a feeling that the largely increased use of oil instead of coal would result in a prohibitive increase in the price of the former. The signing of this bill may at least help to postpone the evil day.

In this connection, however, it is well to note that the country's supply of petroleum is not inexhaustible. Fuel oil offers many advantages for the power plant, but it is little short of criminal to waste it. Conservation of our natural fuel supply is a vital necessity, and conservation of our limited oil supply is especially important.

Referring to the proposed cut in appropriations for promoting foreign trade, from $1,658,000 to $490,000, Secretary Alexander of the Department of Commerce says, "This is the most serious blow ever aimed from within at our foreign trade." The sum allowed is only one-half of the appropriation now used. This cut in funds will abolish entirely the commercial attachés of embassies in a dozen different countries, will greatly reduce the number of trade commissioners who are reporting on rapidly changing commercial conditions in Europe and will close up almost all of the district offices in this country. The point considered most vital is the loss of the commercial attaché system, which has been so highly commended by many business men with a knowledge of foreign trade. In short, at a time when other countries are bending every effort to establish their foreign trade, this bill would cripple the machinery by which the United States keeps in touch with the commerce of the world. In the name of economy we are to smash our carefully built up, smooth-running, trade-promotion machine and then spend many times as much money to put it in running order again when the error of shutting it down has been demonstrated. And it will be demonstrated in a very few months.

CORRESPONDENCE

Frozen Boiler Connections

In reference to the boiler explosions published on page 175 of the Feb. 3rd issue, I would like to say that ice forming conditions are altogether too prevalent in some boiler rooms. In spite of all the safety precautions demanded by law and although there are careful well-trained boiler-room employees, there are thousands of plants that are exposed to the cold, due doubtless to the close-fisted attitude maintained by the owners.

I recently worked at a plant where the boiler blow-off pipe would freeze up during the day's run, between the valve and the cock, if both were closed and no blowing out was done oftener than once in 10 hr. in real cold weather. It is not uncommon for a steam gage connection to freeze and the gage register a false pressure.

J. FOREST.

Norwood, Ohio.

Compressed Safety-Valve Springs

After reading the account of the Interstate Iron and Steel Company's explosion, page 175 of the Feb. 3 issue, and also the editorial in the same issue, it seems quite possible that the accident was due to the defective condition of the safety valves.

As suggestions are in order to prevent future accidents, the following may be of value to operators and owners of plants. I have had several years' experience in the inspection of boilers and have found several cases where safety valve springs, especially old ones, were so compressed that the normal lift was so reduced that even though a valve would open at the pressure at which it was set it would not discharge anything near the amount of steam generated in case of a shutdown of the engine. I have known of cases where the pressure increased from 75 to 100 lb. while the valves were blowing, and if in such a case the steam gage happened to be defective trouble would very likely result, possibly a boiler explosion.

This condition of safety valves has received very little attention from boiler operators or others, but I feel that it is worthy of due consideration. If boiler attendants would occasionally take the time to shut the stop valve while the boiler is run to full capacity and beyond, they could readily determine the capacity of the safety valves and if deficient a new spring or a larger valve could be provided.

Frozen steam gages and their piping are often met with during the winter weather. This is a source of danger particularly to the class of men who are ignorant or careless in their work. There is a remedy for this condition, which is inexpensive and easily carried out. If the piping and gage are thoroughly drained and then filled with a reliable freeze proof mixture such as can be purchased, there will be no occasion to drain the piping for the season and freezing will not occur. There may be cases where an alcohol mixture or kerosene will serve but the first mentioned seems to be better suited for such a purpose.

JAMES COYNE.

Pittsburgh, Penn.

Air in Steam Boilers

The suggestion is made in the article relating to the boiler explosion at East Chicago that it was due to overpressure because the safety valves failed to function, due to ice that clogged the vent pipe, in spite of the fact that there had been a fire under the boiler for seven hours. The assumption is also made that air was trapped in the boiler when it was filled and that it acted as an insulator, keeping the steam in the boiler from reaching the top of the drum and thus thawing out the safety valve.

My experience tends to disprove this assumption. When getting steam up on one of eight 400-hp. boilers a $\frac{3}{4}$-in. bleeder valve, located under the stop valve was left wide open to allow the air to escape. On several occasions, when some one of the operating crew had shut this bleeder when the pressure reached 50 lb., because of the roar of the escaping steam, we would lose vacuum on both condensers, when the boiler was cut in on the line. Even though the bleeder was left cracked until the boiler went in, a noticeable drop in vacuum always occurred so that it became customary to speed up the vacuum pumps whenever a boiler was to be cut in.

If stratification takes place in the drum the air would collect in the nozzle under the stop valve and escape through the bleeder. The fact that air is present in such quantities in the boiler as to interfere with the condensers, in spite of the bleeding, proves that the air and steam intermingle, doubtless due to a counter-current being set up in the steam and gas by the circulation of the water in the drum.

In this particular case the explosion may have been caused by a frozen safety-valve vent pipe, the ice remained despite the heating from the steam, and not because air was present which prevented the steam from reaching and thawing the valves.

Perth Amboy, N. J. ADOLPH QUADT.

Frozen Safety Valve Discharge Pipe

The account of the boiler explosion at the Interstate Co.'s plant in the Feb. 3 issue brings to mind an experience I had with the same make of boiler, but used as a waste-heat boiler over a furnace and for heating material for steel forgings. The furnaces were started early one Monday morning so as to have a heat ready for the forgers when they came at 7 o'clock.

The boiler before that time furnished steam for a boiler-feed pump and for a small engine running a forced-draft fan for the furnaces. Shortly after 7 o'clock I went to the forge shop and the engineer called my attention to the steam gage which registered at 135 lb. The spring pop safety valve set at 125 lb. was not blowing. The hammers were at that time running, taking some steam.

I went on top of the boiler and found that the valve and the pipe leading from the valve to the outside through the roof were frozen. I worked the lever and hammered the pipe until the steam began to leak through the valve a little and finally blew. The engineer who was watching the end of the pipe from the outside said that a piece of ice shot out of the pipe for a distance of about 100 yd. out on the marsh. I think the pipe became full of snow and sleet on Sunday, while the furnace fires were banked, due to a sleet storm that blew right into the mouth of the pipe and froze solid.

I believe that every safety valve that blows outside of a building through a pipe, should have an elbow opened downwards on the end of pipe. This will prevent snow and sleet from getting into the end of the pipe and freezing. Be sure that there is a drip hole in the body of safety valve, above the seat that will drain any leakage from the valve and that the valve above the seat will not then be covered with water and possibly freeze.

Chester, Penn. FRANK MCLEAN.

National Engineer's License Law

I have read with much interest the letter by Mr. Reed—"National Engineer's License Law"—on page 234 of the Feb. 10 issue. Having been an engineer in Massachusetts when the license law was enacted, I feel that I should know something about it. It was an up-hill undertaking to get the wheels in motion that finally drafted a law, and after it became effective the engineers in general were more or less dissatisfied. It would be the same thing if a National engineer's license law were enacted.

There were engineers in Massachusetts who had been operating plants of perhaps 160 hp. for several years. A first-class engineer's license permitted the holder to have charge of an unlimited amount of horsepower; a second-class engineer's license permitted the holder to have charge only up to 150 hp. A clause was inserted in the law that provided for the engineer who was unable to pass an examination.

Operating a plant as chief for five years entitled the said operator to a license (without examination) sufficient to cover his plant. Therefore many an engineer operating a plant of slightly over 150 hp. for five years was given a first-class certificate. The same thing applied to the lower grade licenses and many a man unable to read or write was granted a license. The licensing of engineers and firemen is simply a "safety first" affair and is not (at least legally) an issue to raise power workers' wages.

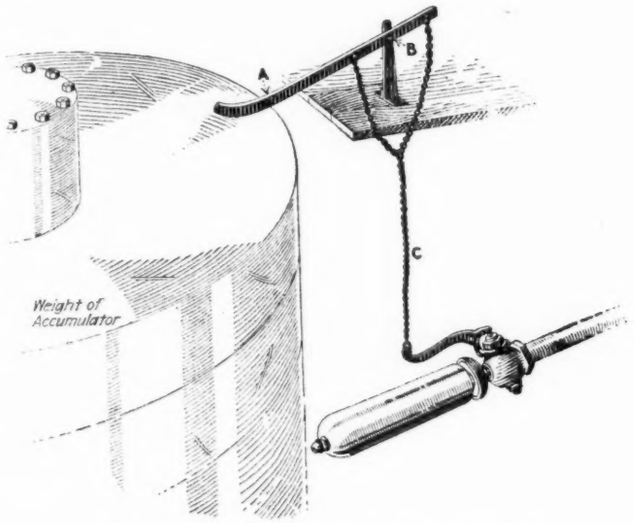
At first the point was raised that it was the boiler that was dangerous, and only this piece of apparatus need be covered by the law, but eventually the majority ruled and engines were covered also.

If a National license law is enacted the illiterate will have to be taken care of in other states as they were in Massachusetts, so for a period of years no apparent results will obtain, but eventually great good will probably come from it. C. W. PETERS.

New York City.

Regulating the Oil Pressure

The step bearings of two vertical turbo-generators were supplied with oil at a pressure of 500 lb., the supply coming from a line under 750 lb. pressure through a reducing valve. An 18-ton dead-weight accumulator connected in with the oiling system supplied



ACCUMULATOR TRAVEL ALARM WHISTLE

oil at the required pressure for a few minutes in case the pump in service became airbound, etc., to allow time to put a spare pump into operation.

The oil pressure was regulated by the height of the accumulator, a ¼-in. cable passing over two small pulleys from the accumulator to a weighted lever valve in the steam line to the pump. The arrangement was not satisfactory as the pumps were kept running with a jerky motion due to the action of the valve lever, which caused the accumulator to bob up and down incessantly with the consequent packing wear and leakage around the accumulator shaft.

To do away with this trouble, a globe valve was placed in the steam line with a 5-in. pulley fastened to the stem, the face of the pulley being made wide enough to allow several turns of the cable. The free end of the cable was weighted just enough to close the valve. The pump action was steadied, but the valve stem threads wore quickly. Upon substituting one of steel the arrangement proved satisfactory.

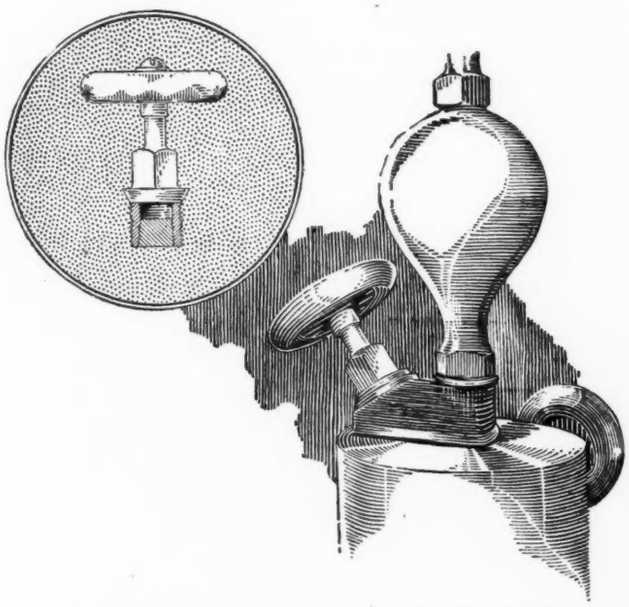
In case the accumulator rose or fell too far beyond a certain position, an alarm, as shown in the figure, would be put into operation. The curved lever *A* was pivoted at *B*, the curved end resting on the top weight of the accumulator, the alarm whistle being operated by the chain *C*. ARNOLD ERICKSON.

Chicago, Ill.

Emergency Repair to Lubricator Plug

The threads on the filling plug of a lubricator became so badly worn that the plug would not hold owing to countless removals and insertions which had blunted the threads. We were some distance from town, and with no repair shop to speak of, it was a problem to get oil into the engine cylinder.

A hole was drilled in the end of the plug to a distance a little beyond the threads, leaving a fair



PLUGGED THE LUBRICATOR FILLING PLUG

amount of stock. A taper pin was filed and driven into the hole to expand the lower end of the plug, thus enlarging the threaded portion. After being expanded until it was a snug fit in the threads in the body, the pin was driven in and the end of the plug peened slightly to hold it in place. Although the threads were worn, the enlarged plug worked very well for some months until the engine was no longer needed. Then the plug was sent to a machine shop for proper treatment.

ARNOLD W. BENTLEY, JR.

Missouri Valley, Iowa.

How the Boiler Blowoff Water Was Utilized

In our plant water does not cost much, but as we have to blow down each boiler twice each 8-hour watch, it is evident that a considerable amount of water is wasted, but what is more serious, it is hot water and it costs money to heat it.

We have a hot pond that has to be kept full of hot water for softening the bark on pulp wood so that the bark can be more readily removed and also to thaw the frozen wood which makes it easier for the chippers. It takes about all a 2-in. steam line can deliver to keep this pond hot.

We piped the blow-off from the boilers into this pond and find that very little live steam is required to keep it hot in the winter and in the summer it does not require any live steam at all.

Van Buren, Me. WILLIAM B. SMITH.

Oil Indicator Gage

Recently the firm by which I am employed installed oil-burning equipment for their boilers. We desired a gage to show the quantity of oil in the tank which is below the ground, and for this purpose adapted a water-level indicating gage similar to those used for showing the elevation of water in reservoirs, etc. The illustration shows the resulting installation.

The gage has a 5-in. dial furnished in black with white enamelled figures and letters and sets on a 5-in. wrought-iron pipe which contains a float resting on the surface of the oil in the tank below. The small pipe at the right guides the counterweight. The dial may be graduated directly in barrels, gallons, or pounds; in the instrument illustrated each division represents 50 gallons. The amount of oil put into or taken out of the tank is readily determined by observing the amount of movement of the dial hand which also shows the amount of oil in the tank.

The measurement of fuel oil in power plants with the usual types of meters presents certain difficulties

OIL GAGE, EACH GRADUATION REPRESENTING 50 GALLONS

which often make its measurement impracticable. The method described herein obviously has great advantages over the old method of measuring black, sticky oil with a measuring rod.

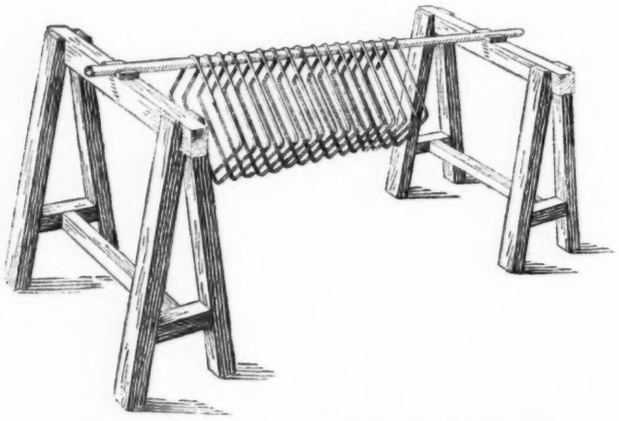
If the float pipe cannot be placed directly over the tank it may be possible to connect the two at the bottom by a small pipe and thus the gage can be located at considerable distance away. If it is not possible to change the location of the float pipe the gage may be located at some distance from it by leading the float cord over special idler pulleys.

Providence, R. I. A. E. WATJEN.

Reinsulating Series Winding of Compound-Wound Motors

Where it is necessary to rewind the series coils of medium- or large-sized compound-wound machines, it may be found difficult to obtain the proper size of wire. In such cases the coils can generally be satisfactorily reinsulated.

First the old insulation must be entirely removed from the copper, which is easily done by subjecting the coil to fire and burning it off. This also anneals the copper and makes it easy to handle. Next the coil is placed on a long piece of pipe that is stiff enough to support it. Then the turns of the coil are very carefully separated, as shown in the figure, after which they can be conveniently insulated with linen tape and the turns may be reassembled as in the original coil.



SERIES FIELD COIL SEPARATED READY FOR REINSULATING

A. A. FREDERICKS.

New York City.

Operating Troubles With Steam Turbines

I have followed with interest the many articles in *Power* in regard to operating troubles with the larger sizes of steam turbines, and in particular the recent discussion which seems to indicate that there is more or less of a tendency for the large low-stage wheels to flutter on the rim. While I have never been in personal contact with these machines, this particular point in their construction has interested me.

When a young man I worked for several years around large circular saws in lumber mills, and while I have seen saws that ran at a rim velocity of 300 ft. per sec., anyone who suggested that they would stand speeds much in excess of that would have been considered crazy.

The important point about these high-speed saws was the amount of strain or tension, as the filer would name it, that was required to keep them from fluttering on the rim. The saw plate was stretched with a hand hammer, on a small anvil, for about one-half the distance between the eye and the rim until the saw was dished like a saucer when standing still. I have seen this dish amount to as much as 4 in. in a saw 5 ft. in diameter, yet when it came up to speed it was straight, the centrifugal force stretching the rim enough to equalize the initial looseness of the center.

While I realize that the present type of construction in regard to clearance, etc., would make it impossible to use this system to the extent of entirely equalizing the strain in the modern turbine wheel, it seems that a certain amount of this initial tension would be beneficial, inasmuch as present design almost fills the bill.

The influence of temperature changes was especially noticeable in these large saws. If the arbor bearing next to the saw collars warmed up even a small amount, the saw would fall over toward the log. Sometimes, when dull, it would crowd the guide pins at the rim, which would cause an increase in temperature that was scarcely noticeable to the bare hand, yet was sufficient to cause a pronounced flutter.

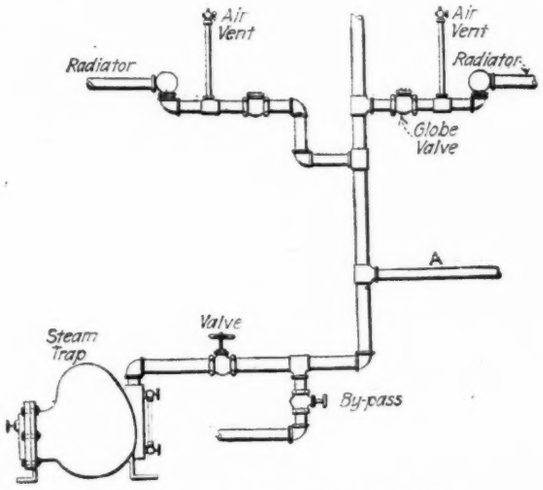
Perhaps if those big turbine wheels ran out in the open where their performances could be observed, some of the experts might discover something new.

Whitehall, N. Y. R. G. YAXLEY.

Faulty Heating System Piping

A certain five-story building 90 x 110 ft. had about twenty ceiling radiators of 1¼-in. pipe. The manner of connecting the drains to the trap is shown in the sketch. It will be noticed that the check valve and air vent on each raidator are at the same level, and as it requires a small head of water to lift the check-valve disk, it will be apparent that the air vents would have to operate on water. That they did this was evident from the fact that the outlets were plugged with bolts, screws and other things that would serve the purpose.

Live steam through a reducing valve was used for heating the building, although an ample supply of exhaust steam passed through the basement of the building to serve a dry kiln adjacent to it. In the illustration *A* is a drain from a special radiator that was served with live steam, but not through the reducing valve, regulation being effected by "cracking" the valve. That often resulted in having the valve wide open, with the inevitable result that a pressure was built up on the discharge side of the check valve, holding it shut and giving the air vent a supply of water on which to operate.



HOW THE PIPING WAS DESIGNED

The installation was made by a reputable firm of heating engineers who would be greatly peeved if their ability were questioned.

R. McLAREN.

Toronto, Ont., Can.

Boiler-Tube Failures

In a recent issue of *Power*, a reader, Mr. Toussaint says that he does not agree that graphite is a scale remover. My experience with graphite is that it will remove scale, and very quickly at that. I know of a case where chemical treatment was unsuccessful. Boiler graphite was used, and the scale came off in large flakes and new scale was not formed. The graphite and scale-forming material was in the form of a soft, black mud and was easily washed out of the boilers. Before graphite treatment was started, no less than sixty tubes were lost in three months. After the treatment was well under way, but twenty tubes were lost in the same length of time.

However, to get good results boilers must be washed out frequently, to the fourth row of tubes at least, as the mud and graphite is sure to cause blisters. I have coated the inside of steam drums with graphite without any beneficial result. One boiler inspector recommends graphite and boiled linseed oil for coating tubes and steam drums.

HERBERT B. BRAND.

Homestead, Penn.

The Fusibility of Ash from Eastern Coals

In *Power* for Nov. 4, 1919, page 655, there were published the results of over 120 determinations of the softening temperature of coal ash, together with the sulphur and ash content of the dry coal.

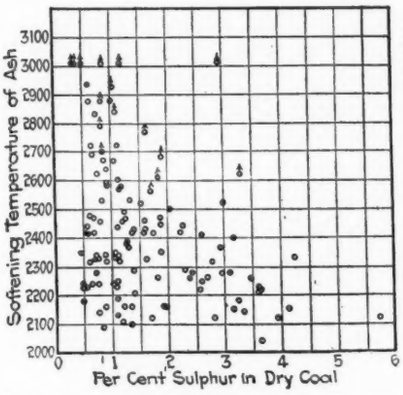


FIG. 1. SOFTENING TEMPERATURE OF ASH PLOTTED AGAINST PER CENT SULPHUR IN COAL

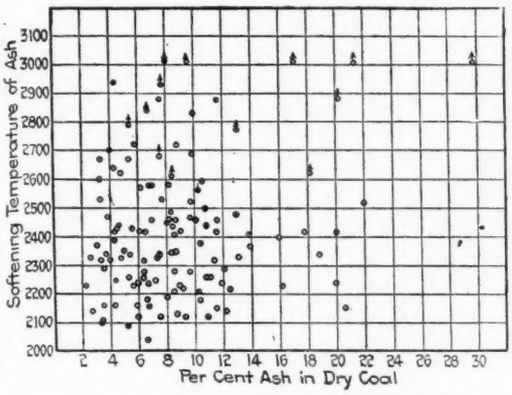


FIG. 2. SOFTENING TEMPERATURE OF ASH PLOTTED AGAINST PER CENT ASH IN COAL

In order to determine whether a relation exists between the softening temperature of the ash and the sulphur or ash content of the coal, I plotted these values as shown in Figs. 1 and 2. The points having arrows attached indicate that the softening temperature is higher than the temperature indicated by the point itself.

In Fig. 1, the softening temperature of the ash is plotted against the percentage of sulphur in the dry coal. From the manner in which the points are scattered, it is clear that there is no definite relation between the percentage of sulphur in coal and the softening temperature of its ash. It does seem to be true that the coals having the ash of highest softening temperature have low sulphur content, and that a high-sulphur coal is quite likely to have a low melting ash; but a low-sulphur coal is quite as likely to have an ash of low softening temperature. Thus the sulphur content of a coal gives us no reliable index of the probability of clinker trouble.

In Fig. 2 the softening temperature of the ash is plotted against the percentage of ash in the dry coal. From the very complete scattering of the arrow points it would seem that there is no relation whatever between the amount of ash and its softening temperature. (One sample included in the data was not plotted, because of its very high percentage of ash, 42.98 per cent, with a softening temperature above 3,010 degrees.)

The results are in no way surprising, but it is interesting to have so good an opportunity to check the facts from reliable data covering a wide range of coals.

Detroit, Mich. G. HAROLD BERRY.

Treating Boiler-Feed Water

I read with interest the communications on the subject of "Boiler-Tube Failures" that have appeared from time to time. It is not my purpose to comment on the theories advanced or objections made to the different ideas or suggestions presented in the articles in the Dec. 16-23-30 issue, page 838, but to call attention to one paragraph in which some unusual mathematical results are given in regard to the quantity of treatment prescribed, or recommended.

The author takes one gallon of treatment to a 100-hp. boiler operating a ten-hour day as the basis of his calculations. The assumption is made then that one gallon of compound weighs 10 lb. A mathematical computation then results in the statement that this would mean one ounce of compound to 6,000 lb. of water. This is a figure I can not understand. An evaporation of 3,750 lb. of water per hour is suggested, and ten times that quantity in ten hours. If 10 lb. of compound are recommended per day this would mean one pound of compound per hour, or one pound of compound to 3,750 lb. of water evaporated.

Assuming that a gallon of water weighs approximately 8¼ lb., this would mean somewhere between 400 and 500 gal. per hour. According to conversion tables one pound per 1000 gal. is virtually the same as seven grains per gallon; one pound per 500 gal. would then be 14 grains per gallon, which would be the quantity of compound introduced into a boiler water on the basis expounded. Fourteen grains per gallon is a great deal; it is more than the total mineral residue in many waters. If properly put together, the reactions should take care of much more than this amount of material.

As I figure it, the dosage referred to is rather excessive, and I simply make the calculations this way, hoping that if the computations are incorrect they will be corrected, and if not that the author will explain the course of arriving at the dosage of one ounce per 6,000 pounds of water. Perhaps some reader of *Power* may have something of interest to say regarding the subject.

Chicago, Ill. D. K. FRENCH.

Every Man Not an Efficiency Engineer

With reference to the foreword "Every Man an Efficiency Engineer" on page 123 of Jan. 27 issue of "*Power*," I wish to take exception to several statements made therein.

It is true that many individuals of meager experience hide behind the much abused name of "Efficiency Engineer," and it seems obvious that since the term engineer incorporates the meaning efficiency—for it is the engineer's function to introduce efficiency in all undertakings—the modifier, "efficiency," should be eliminated. All reputable engineers must first be efficient to call themselves engineers at all.

While it is also true that the importance of the cooperation of all concerned in the operation of any plant cannot be overestimated, I think that, generally speaking, such statements as—"It will be necessary to call in outside aid to find the weak spots, and to devise better methods of doing things," and "No man can be as familiar with the workings within a shop as he who spends day after day at his bench, at his lathe, or on whatever his job may be," leave a wide field for argument as to the soundness of this reasoning.

In the operation of a plant, the heating load, steam requirements for processes and energy generation must be treated as a closely interrelated unit and must be carefully balanced against each other. The individual interest of efficiency engineers can only result in individual economies, but cannot yield the bigger economies which usually result in working combinations. To make the latter more clear, I will mention a specific case, which must not be considered highly unusual.

In a certain wood-working establishment, a dry kiln, consuming as much steam as the Corliss engine unit that was operating the plant, was operated with live steam, whereas the Corliss engine was running condensing. No matter how much dry kiln or engine operation were improved, the broader economy to be secured by running the engine noncondensing and exhausting into the dry kiln had never occurred to anyone, since no knowledge had been obtained of actual steam quantities involved.

It has been my experience that the bigger and more intricate a plant becomes, the more likely will be the man in charge to fail to recognize combinations. It is not frequently the case, that a man with thorough general engineering knowledge, embracing heating, ventilating, steam, hydraulics and electricity generation, is in charge of such a plant for obvious reasons, and a man would have to "work at his lathe" for many a year before he could analyze such problems.

Combined Experiences Better Than Individual

The experience of a corps of organized engineers should always be able to treat such a combination of problems to better advantage than any one man who will not usually be master of all.

It does not seem true that he who is at the same bench or lathe knows better the workings of his routine than an outsider. We are all more or less slaves to habit, and the more we are confined to routine, the more we lose sight of possibilities. It is usually he who performs a routine task who is more blind to betterments, for in his routine he has developed certain habits and has formed partialities and prejudices. The outsider who can view matters in the perspective, and who has had wider experience in having been in intimate contact with the experience of others can serve to good advantage as a clearing house.

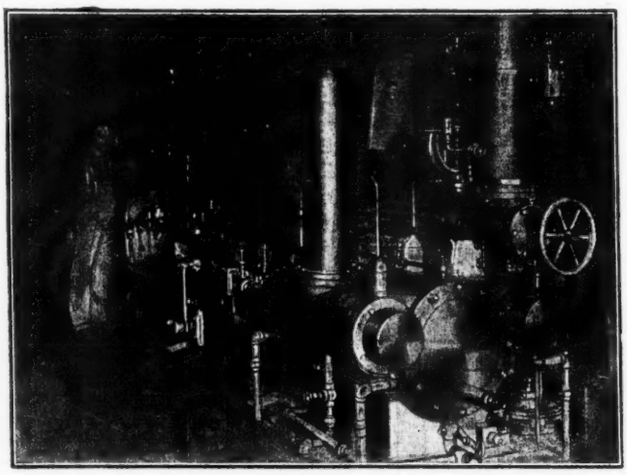
An engineer who can solve such problems must have trained his faculties of observation and developed an analytical mentality; and "working at a lathe," or at any routine task, tends in exactly the opposite direction.

This much in defense of the reputable consulting engineer, who is not a child of charity, but one who is as necessary in the economical operation of power plants as the physician is necessary to human life.

Milwaukee, Wis. Cornelius G. Weber.

Peculiar Engine Design

In going through my Nov. 11-18, 1919, issue of *Power*, I note an engine of peculiar design. I would say that it is an "Estey" engine and was built about 1880 or 1890 by the Novelty Iron Works, of Dubuque, Penn. I have among my engineering files a copy of the catalog



AN ENGINE OF PECULIAR DESIGN

then issued regarding it. Such items are interesting in that they serve to recall to us old-timers the hysterics and convulsions the steam engine has gone through in the past forty years. W. V. White.

Hamilton, Ohio.

Boiler Bagged Due to Muddy Water and Neglect

After reading the article on page 108 of the Jan. 20 issue of *Power*, by Edward Jesse, in regard to the boiler that was bagged owing to muddy water, I am of the opinion that the engineer in charge of the plant was to blame, because I considered that he had full charge and could have made the necessary changes required to get the water from the river, and also that, as he was using water from the mine, he should have taken care of the boiler by washing it out at least every fourteen days and used the boiler blowdown not less than once every eight hours.

Nearly every case of bagged boiler is caused by neglect. This case was no doubt neglect on either the engineer's or the manager's part. If the engineer really had charge of the plant, it was his neglect because he did not take proper care of the boiler and because he did not get better feed water when it was so handy.

Chicago, Ill. L. B. Shields.

INQUIRIES OF GENERAL INTEREST

Girth Seams Lapped Toward Fire—What is the disadvantage of having the ring seams of a horizontal return-tubular boiler lap toward the fire?

The outer plate of the lap is more or less overheated and has a tendency to expand away from the inner plate and cause leakage, and more especially when the lap is toward the fire, as the calking is exposed to the direct impingement of the heated gases.

Banking Fire with Coarse Coal—We have been accustomed to use run-of-mine bituminous coal, employing the smallest sizes for banking fires. The last coal shipment received was nearly uniform stove size, and we are troubled to hold a banked fire. How should the banking be done?

Prepare a heavier bank of clean live coals sloped against the bridge-wall and covered with a layer of fresh coal. To hold the fire, blanket the bank with a thick enough layer of fine ashes to prevent a draft through the coals. For restarting the fire, drag off the ashes and only enough of the top layers of coal to leave a bank of clean kindling coal.

Increasing Length of Meter Connections—In connecting up alternating-current meters on the switchboard, does it affect the accuracy of the meter to splice four or five feet of wire to the potential- and current-transformer secondary leads so as to make them reach the meters? V. K. S.

The only case where the accuracy of electrical measuring instruments is affected by a change in the length of the leads is when the instrument is connected to a shunt, such as direct-current ammeters and in some cases the current coils of watt-meters. With alternating-current instruments connected to the secondaries of transformers the length of the leads may be changed without affecting the accuracy of the instrument.

Choke-Coil Voltage—What determines the voltage rating of choke coils such as are used with lightning arresters? W. A. M.

The voltage rating of a choke coil used with lightning arrester has in general no reference to the coil, but to the insulators on which the coils are mounted. A coil designed for 100 amperes would be practically the same whether used on a 11,000-volt circuit or 33,000 volts, but the insulators for the 33,000-volt coil would have to be designed to withstand three times the voltage of the 11,000-volt coil. From a protective standpoint the 33,000-volt coil would be perfectly satisfactory on a 6,600-volt circuit, but from the commercial side the cost of insulators would be necessarily high.

Conversion of Inches of Vacuum to Pounds per Square Inch—What pressure per square inch would be equivalent to 26 in. vacuum? E. C. H.

A column of mercury 1 in. high at ordinary temperature exerts a pressure of 0.491 lb. per sq.in., and "inches of vacuum" signifies the number of inches of mercury-column pressure less than the pressure of the atmosphere at the place of observation. When a vacuum gage indicates 26 in. vacuum, the pressure is $26 \times 0.491 = 12.766$ lb. per sq.in. less than the pressure of the atmosphere. The absolute pressure of the atmosphere varies with the elevation of the place. At sea level it usually is assumed to be 14.7 lb. per sq.in., so that at sea level the absolute pressure for 26 in. vacuum would be, $14.7 - 12.766 = 1.934$, or practically 2 lb. per sq.in. absolute.

Live Steam Wasted Through Back-Pressure Valve—Why is our boiler called upon to generate more steam when heating the building by adding live steam to the exhaust of the engine operated with a light load than when there is a heavy load on the engine and plenty of exhaust for the heating without addition of live steam? C. T. B.

The greater amount of steam used when the exhaust is supplemented by live steam undoubtedly arises from the escape of more steam to the atmosphere through the exhaust back-pressure-relief valve. When live steam is used to supplement exhaust for heating, it should be supplied through a pressure-reducing valve that will regulate the supply at a pressure several pounds below the relief pressure of the back-pressure valve. Otherwise there is likely to be great waste of live steam in attempting to satisfy the requirements for heating.

Galvanizing Process—How are water fittings and other articles galvanized for the purpose of resisting corrosion? B. N. M.

The articles to be galvanized must first be pickled in a dilute acid to remove or loosen all surface dirt and scale, and when removed from this bath, the articles are well brushed with brooms or steel brushes and washed by dipping in fresh water or with clean water from a hose. They are then placed in a weak bath of muriatic acid to insure a clean metallic surface and taken directly from this bath to a flux bath that consists of a hot solution of sal ammoniac covered with beef tallow. From the fluxing bath the articles are lifted dripping and immediately lowered into the galvanizing bath. This consists of molten zinc, contained in a pot or iron tank surrounded by brick walls, with space enough between the walls and the tank to maintain a coke fire or heat of gas flame for keeping the zinc melted. The articles to be galvanized, suspended from wires or supported in a wire basket, are lowered in the zinc bath for a few minutes and then lifted out and allowed to cool.

Equalization of Draft of Boilers Set in Battery—We have three horizontal return-tubular boilers set in battery, each provided with a 48 by 16-in. uptake, and all discharging into a 48-in. diameter stack connection. There is difficulty in obtaining equalization of the draft, especially when one of the boilers is operated with a forced draft. How can the trouble be remedied? W. G. J.

For obtaining the most benefit from smoke connections of a given size, all junctions of the uptakes with the main stack connection, and junction of the latter with the stack flue, should be made with easy bends so that flow of the gases may be smooth and continuous. To obtain equalization of the draft, each boiler uptake except the one farthest from the stack should be provided with a baffle for so directing the course of the gases that, when discharged into the main connection, their flow will be toward the stack before coming in contact with gases discharged by other boilers. By this arrangement the gases discharged from a boiler with stronger draft exert a jet-pump action rather than an obstruction to the discharge of the furnace gases from the other boilers.

[Correspondents sending us inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications and for the inquiries to receive attention.—Editor.]

Economical Supply of Electric Power

IN A symposium entitled "Economical Supply of Electric Power for the Industries and the Railroads of the Northeastern Atlantic Seaboard," by W. S. Murray, W. L. R. Emmet, J. F. Johnson, H. G. Reist, F. W. Newbury, W. B. Potter, Philip Torchio, Percy H. Thomas, W. D. A. Peaslee and A. O. Austin, presented at the midwinter convention of the American Institute of Electrical Engineers, held in New York City, Feb. 18-20, are discussed the problems involved in the superpower system proposed for the industrial district along the North Atlantic Seaboard. Abstracts from this symposium and discussion thereon follow and show that such a system as proposed can be installed and operated at pressures as high as 250,000 volts.

In outlining what the proposed superpower plan is, W. S. Murray said in part: "The superpower plan, briefly summarized, provides a means by which a present estimated machinery capacity of 17,000,000 hp., divided 10,000,000 for industrial purposes and 7,000,000 for the railroads, in a region between Boston and Washington and extending inland from the coast 100 to 150 miles, now operated with a load factor not exceeding 15 per cent, can be lifted to a load factor greater than 50 per cent and possibly to 60 per cent, and a means by which, conservatively speaking, one ton of coal will do the work of two, and the railroads within the above zone and those carrying coal into that zone will be relieved of transporting one-half of the amount required for power and lighting purposes. In short the value of machine capacity from a utilization standpoint will be increased from threefold to fourfold, and coal resources for the purpose named being conserved twofold. This means that a present plant capacity of 17,000,000 hp. can be replaced by one not greater than 5,500,000 hp., and that not less than 30,000,000 tons of coal per annum can be saved, which at $5 per ton will represent $150,000,000 per year.

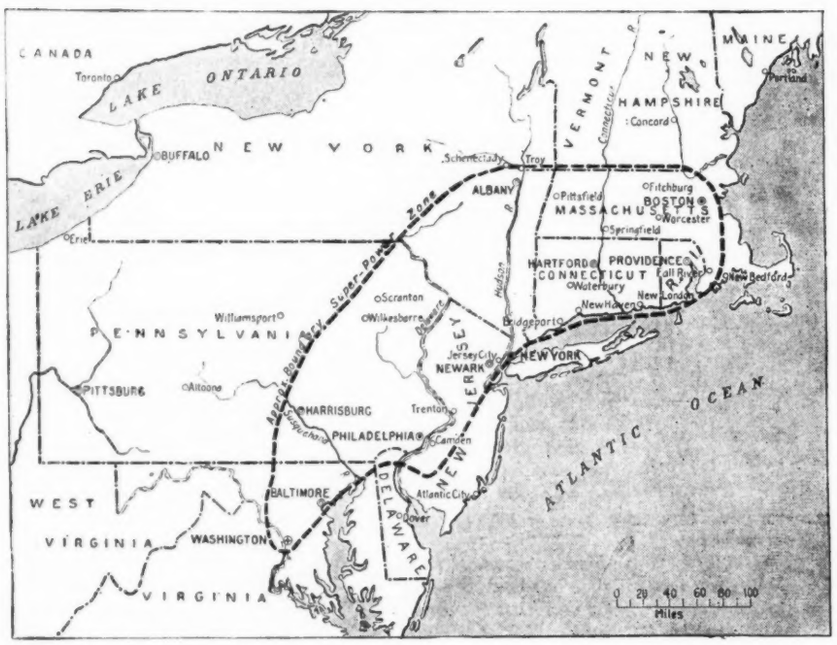


FIG. 1. MAP SHOWING APPROXIMATE SUPERPOWER ZONE

"Besides the foregoing savings, two great departments of economy will be created; one applying both to the railroads and industries, in the reduced cost of maintainence of machinery, and the other applying to the railroads alone in the reduction of train miles. It is estimated that these latter economies will effect a saving of another $150,000,000 annually, thus making a saving of $300,000,000. The foregoing are the direct savings as estimated from data collected from actual past operation of the specific order contemplated to be put into force in the zone under consideration.

"This plan offers immediate relief from the present intolerable congestion of our railroads by automatically increasing rail capacity without increasing track mileage, and reducing power equipment to a minimum. By the creation of an overhead common carrier system of power, the present cargo space now required for industrial coal will be cut in half; train equipment in all classes will have its service practically doubled, and the present steam-power equipment, replaced by electrical equipment, can be transferred to other divisions where it is so vitally needed. The superpower plan contemplates the general application of electricity wherever economically possible in the factories or on the railroads in the zone described."

W. L. R. Emmet, in discussing large steam turbines, pointed out that "the best steam-turbine station equipment, operating under favorable conditions can deliver a horsepower-hour in the form of electricity with an expenditure of one pound of coal, where four pounds are required to deliver a horsepower-hour to the draw bar of a good locomotive. The locomotive is subject to many disadvantages; its fuel supply must be delivered and stored on a relatively small scale, in many inconvenient places, and its efficiency is greatly affected by conditions of temperature. The water supply is also a matter of much trouble and expense. While the comparison of efficiency between the large power station and the smaller engine or turbine equipment used in small stations and isolated plants is less striking than that with the locomotives, it is nevertheless highly unfavorable to the small plant."

J. F. Johnson expressed the opinion that "The design of the steam-generating stations such as would be required, would probably not differ materially from those being employed for the larger and most modern stations now building, and their efficiency would not differ materially from those now obtainable except as affected by the higher load factor under which they would operate.

"Reliability would, of course, have to be the first aim of the designer, and this requisite would preclude the adoption of experimental apparatus or conditions widely removed from those now used in order to produce satisfactory results. Generating stations of some 200,000- to 300,000-kw. capacity, employing generating units of some 60,000- to 75,000-kw. capacity, each operated on steam conditions of 300-lb. pressure, 200-deg. F. superheat and 29-in. vacuum referred to a barometer of 30 in., would involve no difficulties of design, construction or operation, and from such stations a steam-consumption rate of 10 lb. or less per kilowatt-hour and a total station rate of less than 1.5 lb. of good-quality coal per kilowatt-hour output should be obtained."

"The size of the generating unit for such a project," said H. G. Reist, "will undoubtedly be determined largely by the output required for individual power houses. It seems probable that whatever frequency is selected for this system of distribution, turbines and generators can be supplied to meet the most desirable number of units to be placed in each installation. So many generators of from 30,000 to 50,000 kva. are at present in operation, giving satisfactory service, that there need be no hesitancy in considering generators as large as those now in use or larger. The potential of these generators should be within the limits of our experience; that is, not above 13,200 volts, and preferably lower, if this does not cause inconvenience in the

lines leading from the generators to the step-up transformers. The efficiency of large modern generating units is very high. The losses may be expected to be less than 2 per cent of the output of the machine. On account of the great capacity of the lines in such a large system, there may be some advantages in the use of induction generators. Roughly, the size of induction generators would probably be from 25 per cent to 30 per cent larger than a synchronous generator and the cost of the machine in proportion.

F. D. Newbury gave his point of view, in regard to the generating end of this subject, by saying that "the generating element in the proposed Boston-Washington power-supply system does not involve anything new or untried. The individual power station need not, and probably would not, be any larger than stations now in operation or under construction. Certainly, any probable station involved in carrying out the superpower development could be designed with steam or electric generating units of a size now available. Suppose we assume a station of 300,000 to 500,000 kw. total capacity. We have available single-shaft generating units up to 40,000 kw. with generators of 50,000-kva. capacity. The preferred speed for such units would be 1,200 r.p.m., 60-cycles. Eight to twelve such units would give the assumed total station capacity. There have been developed and built triple-shaft compound units of 60,000 kw. Five to eight such units would constitute as large a station as has been suggested. All the generating units referred to are actually conservative in size and by no means represent the largest unit of the speed in question that could be designed."

From a consideration of data available on railway operation W. B. Potter draws the conclusions that "of the whole mileage included in the zone, a not very large proportion has been electrified, but main-line electrifications now in operation are of sufficient extent to carry tonnage of a character to present data that can be fairly applied to the traffic of the whole district. The traffic within the zone now handled by steam locomotives, if handled electrically, would require an average output of less than 750,000 kw. and if produced entirely by coal-burning electric-power station, would reduce the coal requirements for transportation purposes from 21,000,000 tons to 7,000,000 tons annually. As a certain proportion of electric power would be produced from hydraulic-power stations, this coal requirement would be reduced in proportion as advantage is taken of hydraulic operations. The reduction in cost of maintaining the motive-power units would be a large amount, which, estimated from the locomotive mileage, would be in the order of $15,000,000 or more annually."

Philip Torchio, in his contribution, discussed the relative values of water- versus steam-power development. From a review of the resources and consumption of coal and the availability of potential water power in the United States, Mr. Torchio said: "The Western States, Mountain and Pacific, have resources in both coal and water to meet indefinitely all the heat and power required from either source of supply, the potential water powers alone being large enough to supply over six times all the heat and power requirements in 1915. The other states, with corresponding heat and power requirements forty times greater than the Western States, have actually smaller resources in coal and potential water power, the latter capable of supplying only 8 per cent of their total heat and power requirements. It follows, then, that these states must indefinitely, as far as present human knowledge can forsee, depend upon the use of coal to supply the great bulk of these needs. These states, comparatively so deficient in water powers, consumed in 1915, 528,000,000 tons of coal, about one-half for generating power and one-half for generating heat. They obtained an average efficiency from coal of 5 per cent for the power and 50 per cent for the heat."

In a comparison of the cost of steam-power plants and hydro-electric developments Mr. Torchio pointed out that the former cost about one-third to one-quarter that of the latter, consequently one dollar invested in steam plants will make available several times more power for industries than a dollar invested in hydro-electric plants. The author urges development of our water powers especially in connection with electrochemical processes and metal refining using immense amounts of power continuously, where the net cost of hydroelectric power may be considerably less than steam power. "There is a great advantage to the whole nation to devoting as much as possible of the economical water

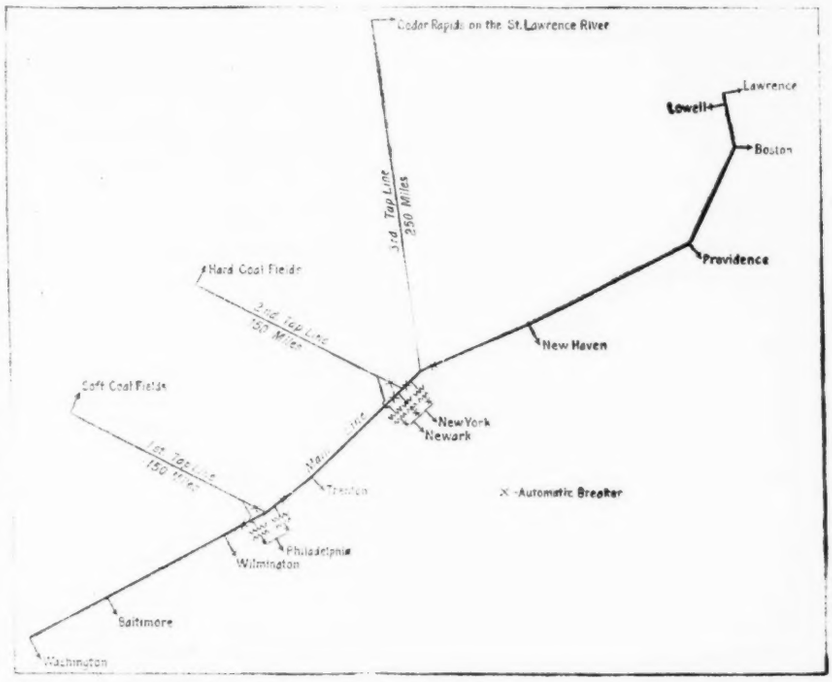


FIG. 2. SUGGESTED POWER-TRANSMISSION SCHEME FOR SUPERPOWER ZONE

powers, particularly those which are continuous or nearly so and those without regulatory daily storage, to intensify the development of these industries which can prosper and render their full benefit to the Nation only under the conditions of mass production and most favorable cost of power. The harassing experiences of coal famines have brought forth repeatedly pressure that immediate efforts be directed to the development of the potential water powers of the country. While from the general standpoint of conserving the national coal resources the proposition deserves the most favorable consideration, it is questionable whether quicker and greater results could not be obtained by concentrating the effort upon improving and changing wasteful methods of utilizing coal."

Tables are given comparing the relative values of hydro-electric and steam power for a number of specific conditions of service which, cover all possible ranges of conditions that may exist for different situations of power production from very large plants, equipped with modern apparatus. In another table "Review of the Supply and Consumption of Coal by Classes and Territories and the Relation Which the Potential Water Power Bears to the Amount of Coal Used in the United States," very interesting information and data on potential water power and coal saving is given.

Percy H. Thomas, in discussing this subject, assumed a transmission line extending from Lawrence, Mass., to Washington, D. C., as in Fig. 2, operating at 250,000 volts, with tap lines running to the various sources of power and large centers of power consumption, and shows that it is within the premise of present engineering practice to construct and operate such a system.

In discussing the capital cost of such a system, the author points out that it may be assumed that a 400,000-kw. power station may be built under reasonably favorable price conditions for $100 per kw., including overhead necessary for design and construction; that the transmission line as proposed (namely, two 150-mile 250,000-volt 400,000-kw. tap lines, and 100 miles of similar capacity line for the central part of the main connecting line, and 250 miles of 200,000-kw. line) can be built at an average cost of $47.50 per kw. generated, including overhead; also, that the necessary 250,000-volt step-up transformers with 250,000-volt switches can be installed for $15 per kw., allowing $1.50 per kw. for miscellaneous cost, gives the total cost for 900,000 kw., allowing 12½ per cent spare as $150,000,000 or $164 per kilowatt. A fair estimate of the cost of installing plants to generate the same amount of power at the several large centers, supposed to be supplied, would be about $125 per kw., leaving an excess capital cost on account of the transmission scheme of $40 per kw., a very small amount for the benefits offered.

Insulators for Proposed System

W. D. Peaslee said that, "The utilization of 220,000 volts or higher for the transmission of power is not a problem that holds any terror for insulator manufacturers." He also called attention to a disk insulator that was being developed and said that "this disk insulator will be very well suited for this particular work, and our research work has progressed far enough so that we feel confident that by the time such a line is an active proposition, we will be able to undertake the installation problem."

A. O. Austin, in speaking of the problem of insulating such a system as proposed, said: "The large conductors necessary for a system such as this, would require heavy working stresses for the insulators. The insulator art, however, is such that, high ultimate insulators with long life can be produced at a much lower price than they could formerly. It is now possible to produce insulators such that a single string will carry the line at a cost probably not more than 50 to 60 per cent of that required for a 110,000-volt line. From this it will be seen that the cost of insulators for a 220,000-volt project will probably be less than the cost of 150,000-volt line previously installed. The transmission art has advanced rapidly and many an economy could be effected by carrying out a comprehensive scheme, which is not possible in many of existing systems."

Discussion on Super Power System

In discussing this project Prof. Malcolm Maclaren suggested that some independent body make a careful study of this situation, and pointed out that the institute could render no greater service to this community at the present time than by urging the creation of a commission which should direct the course that these developments should take.

The speaker called attention to the power requirements of a portion of this district, namely, eastern Pennsylvania, New Jersey and New York City. This portion he divided into four industrial districts, one including Philadelphia and extending along both banks of the Delaware River from Chester to Trenton; another centered around Newark, reaching from Paterson in the north to Perth Amboy in the south; the third is confined within the limits of greater New York; and the fourth includes the anthracite-coal fields extending south to Allentown, Bethlehem and Easton, which may be designated as the Lehigh district. From a recent analysis made by Prof. Maclaren the results show that for the Philadelphia district the maximum demand would be approximately 700,000 kw., for the Newark district 550,000 kw., for the Lehigh district 650,000 kw., and for the New York district approximately 700,000 kw., making a total of 2,600,000 kw. The most promising methods for obtaining additional capacity in this district, says Prof. Maclaren, are "by hydroelectric developments on the Susquehanna River, hydroelectric developments on the Delaware River and by construction of steam plants at the anthracite mines. The largest single development projected for the Susquehanna River, at Conowing, near the mouth of the river, will have an initial capacity of 125,000 kw. and will be capable of producing approximately 700,000,000 kw.-hr. in a dry year. This 700,000,000 kw.-hr. represents only about one-third of the energy of the river at Conowing, and with a relatively small amount of river control it should be possible to increase the output at this point and develop other sites that would yield between 200,000 and 300,000 kw. and 1,500,000,000 kw.hr. annually. By plans that are well advanced for the development of a series of hydroelectric plants on the Delaware River, this river would be capable of producing 250,000 kw. of primary power and 1,000,000,000 kw.hr. annually.

"Considering next the construction of steam plants at the mines, it should be noted that it may not prove feasible in the present state of the art to install in the anthracite region superpower plants of 300,000 kw., or more, such as has been proposed for other districts, as there are few if any sites in this district where there is combined an adequate supply of the smaller sizes of coal with water conditions suitable for operating a plant of such magnitude.

"The report of the Bureau of Mines for Pennsylvania shows that for a total annual production of 80,000,000 tons of anthracite for this district, over 8,000,000 tons was used in mine operation. Data obtained from the electrified mines of the district indicate that if all the mines were electrified from a central-supply system, this 8,000,000 tons now being used for mining coal would be capable of supplying all the needs of the coal companies and leave a balance sufficient to operate a generating system of over 600,000 kw. capacity at 50 per cent load factor.

A Picture of a General Power Scheme

"The picture that might be formed of a general scheme to be followed in the next ten years to meet the growing needs for power within this territory is that the power companies in the large cities should in general complete their present construction programs, but should not greatly increase their generating facilities beyond this point, additional capacity being obtained by the construction of steam plants at the mines, reinforced on the east by hydro-electric plants on the Delaware River and on the west by hydroelectric plants on the Susquenhanna, the whole of the territory being interconnected with transmission circuit."

Prof. Charles S. Scott reviewed the growth of electrical power devices, during the past 13 years and said that with the load doubling every five years it is absolutely necessary to consider some economical means of providing an adequate power supply to meet the requirements of the future. The superpower scheme offers one of the solutions to the problem.

N. W. Storer referred to the shortage of labor and fuel being experienced by the railway companies at the present time and said that they should take a lesson from the housewife and do it electrically. The speaker said that the electric locomotives can do more work than the steam locomotive and do it better, and do it on one-third of the coal burned in a steam locomotive.

Electrifying of All Industries

D. B. Rushmore reviewed the changes that led up to the present industrial development and said that industry in this country is bound to increase, and with labor becoming more expensive, the situation can be met only by an increased use of power, which means the electrifying of all industries. On the suggestion of Professor Maclaren and Mr. Rushmore a motion was put by H. W. Buck that the board of directors be requested to appoint a committee with W. S. Murray as chairman to give the support of the American Institute of Electrical Engineers to the superpower plan. The motion was carried.

W. D. Peaslee announced that from the result of an investigation his company was now ready to provide insulators up to 350,000 volts and ready to guarantee them.

E. E. F. Creighton said that in the very near future means would be available whereby any disturbance from lightning would be removed from the line in a few hundredths of a second.

J. W. Lieb called attention to the fact that an adequate power supply is one of the most important economical problems before the nation at the present time, therefore it should have the support of the American Institute of Electrical Engineers. The engineer should view the problem with a broad national outlook and not make the mistake of the railroads by a battle over the different systems. Every day's delay makes the consummation of the superpower plan more difficult. The speaker referred to the question of both voltage and frequency making the problem involved and illustrated this point by our experience during the war, when New Jersey was short of power, and in New York City 100,000 hp. was available, but could not be connected with New Jersey's power system on account of a difference of 2½ cycles between the two systems. Mr. Lieb announced that this difference, however, no longer existed, since the New York Edison Co. has recently changed the frequency of their system from 62½ to 60 cycles. Mr. Lieb laid great stress on the necessity of continuity of service and said that in a community like New York City, the seriousness of interrupted service, even for a short time, would be impossible to exaggerate, therefore it should be assured by everything that money can buy, that human foresight can propose and that engineering ability can provide.

Chicago N. A. S. E. Welcome National Officers

On Saturday night, Feb. 28, the combined N. A. S. E. associations of Chicago assembled 350 strong to greet the national officers at a banquet held in their honor at the central Y. M. C. A. Auditorium. The officials were on their way to Milwaukee to make arrangements for the next annual convention. With representatives of the Chicago Association of Commerce, the Manufacturers' Association and the Building Managers, present upon invitation, the banquet was made a booster meeting. For forty years the association has been working along quietly, hiding its light under a bushel, and it was felt that it was high time for publicity on the aims and objects of the association, what it stands for and what it has been doing for the last forty years. The various officers taking part in the program brought out from various angles the features in the preamble and one and all eloquently expressed the ideals of the association. Education, economy, the enactment of license laws and harmony between employer and employee were the features brought to the fore. "To earn more, learn more" is the guiding spirit of the association, which sets its face against the furtherance of strikes or interference of any kind between its members and their employers. In these days of social unrest, bringing sudden changes and reversals of pre-war conditions, an association founded on the principles previously outlined is an exception worthy of the highest commendation. The men who pay the wages of its members should know all about it, and the various speakers took pride in laying their claims before them.

Tom McNeill, chairman of the entertainment committee, introduced Alfred Johnson as toastmaster for the evening, and in turn he called upon President Callahan, who was followed by W. M. Ellis, of the Building Managers' Association, Homer J. Buckley, of the Chicago Association of Commerce, the following officers of the association: Joseph F. Carney, William Reynolds, John A. Wickert, C. W. Naylor, Joe O'Connell, Fred Raven, "Dad" Beckerleg; and Homer Smith, of the Exhibitors' Association.

During the evening it was brought out that the association is in a better position than ever before. The paper is prospering and the drive for a 25 per cent increase in membership is progressing favorably. New Jersey has high hopes of pulling down the prize, but New York and other states expect to offer close competition, and Wisconsin, with the convention coming to Milwaukee, has already shown an increase throughout the state of 25 per cent, with several months to go.

Passing on to Milwaukee, the officers were given a rousing reception at a beefsteak dinner Monday night and participated in the formalities attending the initiation of 75 new members. On the following evening they had the pleasure of initiating almost as many in the rooms of No. 1 association, Chicago.

Military Engineers' Society Is Being Organized

A national association of present and former officers of engineers and civilian engineers who have served in any arm or branch of the U. S. Army—to be called the Society of American Military Engineers, is being organized by a committee appointed by the Chief of Engineers. The society's objects are to promote the science of military engineering and to foster the co-operation of all arms and branches of the service, and of civilian engineers, in that science. The objects and a provisional constitution of the society have been approved by the Chief of Staff.

A letter ballot from all engineer officers in the service and a canvass of representative opinions among officers who had been in the service during the war showed a strong majority in favor of such a society. The committee originally appointed to consider the feasibility of a technical organization, therefore, drafted a provisional constitution and created a temporary board of directors from its membership.

The annual meeting is to be held in Washington, and its date is fixed with reference to that of the American Society of Civil Engineers in order to make possible attendance of members at both meetings. The dues are fixed not to exceed $5 per year, those for the present year being $4.50.

The society is to publish, bi-monthly, a journal to be called "The Military Engineer," which will supplant "Professional Memoirs" heretofore published by the Corps of Engineers.

Further information regarding the society may be secured from Col. G. A. Youngberg, Office, Chief of Engineers, U. S. Army, Washington, D. C.

A. I. E. E. Boston Meeting

The Boston meeting of the American Institute of Electrical Engineers will be held, April 9, 1920, jointly with the American Electrochemical Society and will be under the auspices of the Boston Section and the Committee on Electrochemistry and Electrometallurgy. Tentative plans have been arranged as follows:

On Thursday, April 8, the American Electrochemical Society will hold meetings, morning and afternoon, at the Massachusetts Institute of Technology, and members of the A. I. E. E. are cordially invited to attend. On Thursday evening at 8:30 a get-together smoker is planned by the American Electrochemical Society at the Copley Plaza Hotel, to which all Institute members are invited.

On Friday, April 9, a joint session will be held at 9:30 a.m. for the presentation and discussion of a symposium, "Electrically Produced Alloys." In the afternoon an inspection trip will be made to the laboratories of the General Electric Co. at Lynn, where talks on research work at the laboratories will be delivered by Prof. Elihu Thomson and others. At 6:30 p.m. a subscription dinner will be served at the Copley Plaza, at $4 per plate. The evening session will be held in the Copley Plaza, at 8:30 p.m., where a symposium will be presented on "Power for Electrochemical Purposes." The American Electrochemical Society will continue its meeting on Saturday.

In order to provide a dependable water supply against the threatened dry season this year, the land owners under the Government project in the Okanogan Valley, Washington are preparing to install one of the most powerful steam pumping plants ever used for irrigation purposes. It is proposed to lift sufficient water out of the Okanogan River to irrigate 5,300 acres of land now in bearing orchards in the vicinity of Omak. This water will have to be lifted to the total height of 470 ft. and pumps having a capacity of 25,000 gal. per min. will be required for the work.

Fatal Boiler Explosion at Seattle

Five men are dead and three others are injured, two possibly fatally, following an explosion, at noon, Saturday, Feb. 14, of a mud drum of a water-tube boiler at the steam plant of the Puget Sound Traction, Light and Power Co., Seattle, Wash. Windows were blown out, brick walls were shattered and the employees of the plant were showered with steam, boiling water and bricks.

FIG. 1. FRONT AND SIDE VIEW OF THE EXPLODED BOILER

The exploded boiler, which had been inspected on Feb. 6, was located in a one-story building adjacent to a five-story building housing five large main boilers. The small building contained two auxiliary boilers, used only in cold weather, or as relief for one of the main boilers when necessary.

Steam had been cut off from one of the main boilers, and the auxiliary boiler that exploded was fired up to take its place. It had been in service about an hour when the explosion occurred.

The boiler was of oil-burning type, encased in a brick setting. The initial fracture is believed to have been in the cast-iron mud drum, pieces of which were found more than thirty-five feet in the rear of the boiler.

Asked for a statement regarding the explosion, Superintendent Santmyer said:

"The explosion, as we now understand it, occurred when the mud drum let loose. The boiler had not been in use since Feb. 6, when it was inspected by the insurance company. The inspector pronounced it in first-class order.

"The boiler was installed in 1906, but was considered still as good as new, as it has not been used except for relief of one of the regular boilers. It was rated at 500 horsepower."

C. D. Paddock, chief boiler inspector for the Hartford company, also stated that his company had made an inspection of the boiler on Feb. 6 and had found it in good order. He said:

"A thorough investigation will be made by City Boiler Inspector William E. Murray and myself to determine just what was responsible for the explosion. I cannot say from the preliminary investigation that I have made that the bursting drum was responsible. It may be that through some sudden change of the pressure the drum was broken, or it may be that the explosion was not in or near the mud drum, but that it was a result of some other condition."

The dead are: William Santmyer, machinist, son of Walter J. Santmyer, superintendent of the Puget Sound Traction, Light and Power Co.; George O. Bunnell, storekeeper; David T. Spurgeon, engineer; T. A. Nolan, steamfitter, and P. H. Jacobs, carpenter. The injured are: T. D. Parr, foreman; Edward H. Huntley, machinist, and Fred Offield, steamfitter.

Spain's available water-power is estimated at 5,000,000 hp., only a tenth of which has been developed. There have been recent developments in hydro-electric power transmission. In Catalonia, the principal industrial district of Spain, works already under construction will add 200,000 hp. to that now in use, making a total for the country of about 700,000 hp. The country has large resources in coal. However, inadequate transportation in the interior has prevented a development of these resources, and while coal might have been exported, it has been imported.

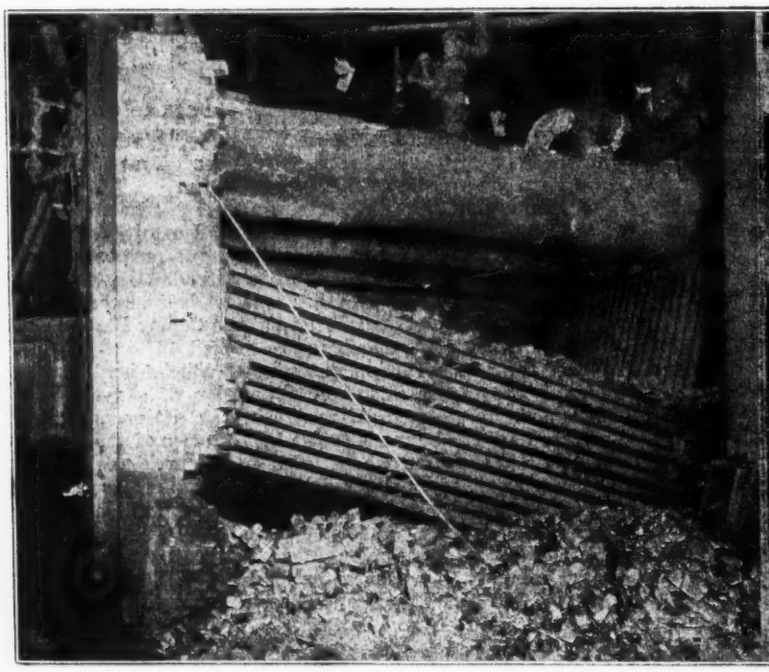


FIG. 2. SIDE VIEW OF THE BOILER AFTER EXPLODED

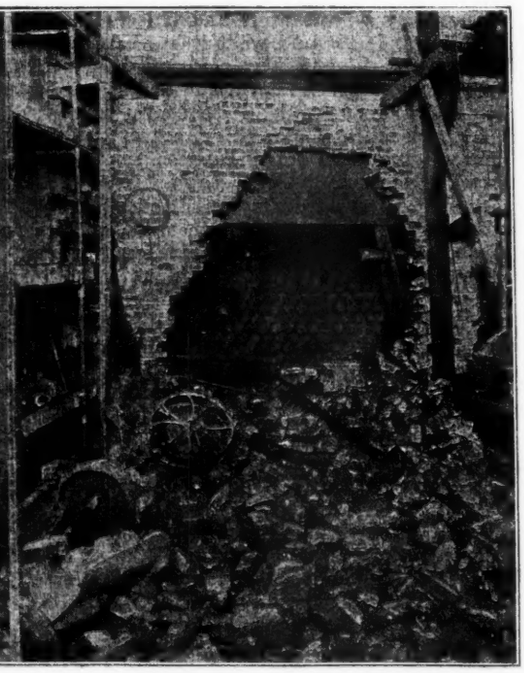


FIG. 3. BACK-END VIEW OF BOILER

One of the World's Largest Steel-Mill Electrical Equipments

AT THE regular monthly meeting of the Philadelphia section of the Association of Iron and Steel Electrical Engineers, R. B. Gerhardt, superintendent of the electrical department of the Sparrows Point plant of the Bethlehem Steel Co., presented a paper on "Electrical Features of a Modern Steel Plant." The author gave a very comprehensive description of the electrical equipment of the Bethlehem Steel Co.'s plant at Sparrows Point, Md., which is now nearing completion after four years of work and involving an expenditure of $50,000,000. In this plant there is installed a total of 2,169 motors having an aggregate capacity of 117,850 horsepower.

The plant consists of an ore-handling plant; coal-handling plant; coke ovens; blast furnace plant; open-hearth plant; bloom and rail mills; bloom, billet and bar mills; 36 x 110 in. sheared-plate mill; 60-in. universal plate mill, and sheet and tin-plate mill. The ore-handling plant is equipped with four motor-operated unloaders, which with three of them working are capable of unloading 10,000 tons of ore from a boat into the storage yard in 16 hours. The electrical equipment of this part of the plant consists of 60 motors having a total capacity of 3,618 hp. A ton of ore can be transferred from a boat into the storage yard and then from here into the furnace stock bins, on an average power consumption of 1.5 to 2 kilowatt-hours.

The coal-handling plant is equipped for unloading either from boats or railway cars. There are two breakers and four crushers in this plant all electrically driven. The electrical equipment in this plant comprises 56 motors totalling 4,100 horsepower.

Coal after passing through the crushers is delivered to the storage bin over six batteries of by-products coke ovens, each comprising 60 ovens. Each battery has a capacity of 750 tons of coke per 24 hours. For the total coke-oven plant including the coal unloading, crushing and by-products plant, there are required a total of 174 motors representing 8,035 hp. The average power consumption per ton of coke is 1.3 kilowatt-hours. The foregoing does not include the power required to drive the gas exhausters, which are driven by steam turbines.

Blast-Furnace Plant Equipment

In the blast-furnace plant there are four 450-ton furnaces in operation and two 500-ton units nearing completion. For blowing the furnaces there are two gas-blowing engine plants arranged for a total of fourteen Bethlehem 47 x 60 in. gas end by 84 x 60 in. air end, including all necessary auxiliaries. There is also a steam blowing plant which contains four Corliss engines, 42 x 88 x 60 in. steam end by 84 x 84 in. air end. Also two blowing engines 38 x 38 x 60 in. steam end by 84 x 84 in air end. There is also a 10,000 hp. gas-fired boiler plant, containing forty 250 hp. boilers. Most of the boilers are not operated unless there is a surplus of gas from the gas engines. A total of 10,887 hp. of motors is required in this plant. Excluding the casting plant and sintering plant, the average power consumption of 6.9 kilowatt-hours is required per ton of pig iron. In the sintering plant an average of 15.5 kilowatt hours per ton of sinter is required.

There are two open-hearth plants in which are installed a total of 237 motors having an aggregate capacity of 12,658 horsepower.

The rolls of both the bloom and rail mills are driven by steam engines operating condensing and supplied with steam from twenty 250 hp. oil-fired boilers. For auxiliary drives in this department there is a total of 136 motors representing 5,190 horsepower.

The bloom, billet and bar mills are located in one building and aranged to roll billets, slabs or bars direct from ingots. A 5,000-hp., 600 volt direct-current reversing motor drives the bloom mill. This motor is supplied with power from two 2,000 kw. 600-volt direct-current generators driven by a 3,000-hp. 6,600-volt induction motor. This mill rolls ingots weighing 16,500 lb., into slabs 9 x 38 in. in 16 passes. Power consumption averages 10.4 kilowatt-hours per ton of finished slabs. Ingots weighing 12,000 lb. are rolled down to 8 x 8 in. blooms in 20 passes in this mill on an average power consumption of 20.8 kilowatt-hours per ton of finished blooms.

A six-stand 24-in. continuous mill driven by a 4,000-hp., 6,600-volt three-phase motor rolls 4 x 4 in. billets or 8 x 2 in. slabs on a power consumption of 9.55 kilowatt-hours per ton of finished product. The 8 x 2 in. slabs go to a six-stand 18-in. continuous mill driven by a 3,250-hp. motor where they are rolled into sheet bars, on an average power consumption of 26.8 kilowatt-hours per ton of finished product. In the bloom, billet and bar mills a total of 18,774 hp. is required in 181 motors.

A 4,000-hp., 6,600-volt slip-ring induction motor drives the 36 x 110-in. sheared-plate mill. The average slabs rolled in this mill are 6 x 38 in. weighing 4,000 lb. and are rolled down to ¾ x 72-in. plates with an average power consumption to the main motor of 21.0 kilowatt-hours per ton of slabs, and on 44.0 kilowatt-hours for the total mill. The total horsepower required in this mill is 8,653 in 122 motors.

Two-High Reversing Plate Mill

A 60-in. two-high reversing universal plate mill is under construction and will be in operation in the near future, and is designed to roll 13 x 62 in. slabs weighing 10,000 lb. down to a ⅜ x 60 in. plate in 21 passes. This mill will be driven by a 700-volt direct-current reversing motor having a maximum peak rating of 17,500 hp. and will operate at a speed of from 0 to 100 r.p.m. in either direction. Power is supplied to this motor from a flywheel motor-generator set consisting of two 3,000-k.w. 700-volt direct-current generators directly connected to a 5,000-hp. 6,600-volt motor and a 75-ton flywheel all mounted on a common bed plate.

In the sheet mill sheet bar is rolled in hot mills arranged in four groups of six-roll stands each. Two of the groups are driven by 1,200-hp. and two 1,000-hp. wound-rotor induction motors equipped with double flywheels and liquid slip regulator. The total connected load in this mill is 6,070 hp. made up of 96 motors. In the tin-plate mill 116 motors are used totalling 5,441 horsepower.

Power for the plant is supplied from two sources, namely, the Consolidated Electric Light and Power Co. and from the Bethlehem Steel Company's own gas-engine driven plant at the mill. Seventeen thousand kilowatts are supplied from the former source at 26,000 volts, over a duplicate transmission line from Baltimore, Md. All the rest of the power required in the mills is supplied from the company's own gas-engine driven plant, in which at the present time five 5,000 kva. generators are being installed. Each generator is driven by a Bethlehem 47 x 60 in. twin-tanden gas engine. The power plant is designed for an ultimate capacity of 100,000 kva. Power is distributed about the plant at 6,600 volts and this distribution system takes the form of a double-ring bus, which originate and ends at the gas-engine plant. This bus consists of 1,000,000-circ.mil. weather-proof cable carried overhead on special cable-top 33,000-volt insulators, mounted on 85-ft. steel towers. On this bus there are located four switching towers with taps to the four principal substations located at the 40-in. blooming mill, 60-in. universal plate mill, 110-in. plate mill, rail mill and coke ovens.

In closing, Mr. Gerhardt paid high tribute to the members of his electrical organization at Sparrows Point, and said it was only through the hearty co-operation of every one in this organization that made possible the result obtained at Sparrows Point during the past four years.

Temporary Fuel Control

By an executive order the President has extended the powers of the Fuel Administration for a period of sixty days from March 1. The control, however, is divided between Director General Hines and a commission of four, consisting of A. W. Howe, of the Tidewater Coal Exchange, Rembrandt Peale, representing the coal operators, and F. M. Whittaker and J. F. Fisher, representing the railroads.

Mr. Hines will retain the jurisdiction over domestic distribution, and the commission, which will function through the Tidewater Coal Exchange, will look after bunker and export coal. Although the office of Director General of Railroads expired March 1, Mr. Hines' authority as concerns coal distribution has been extended for the period stated.

It is specifically directed that the order issued by the United States Fuel Administration Nov. 6, 1917, relative to tidewater transshipment of coal at Hampton Roads, Baltimore, Philadelphia and New York, and for the employment of and co-operation with the Tidewater Coal Exchange, as a common agency to facilitate transshipment and to reduce delays in the use of coal cars and coal-carrying vessels, suspended by Dr. Garfield on Feb. 20, 1919, be reinstated.

New Publications

HENDRICKS' COMMERCIAL REGISTER of the United States for Buyers and Sellers, 1919-1920. S. E. Hendricks Co., Inc., New York City. Cloth, 2,703 pages. Price $12.50.

The 28th Annual Edition of "Hendricks" has just been published, after having been delayed for two months by the strike of the printers. The new edition contains several improvements, the most noticeable being the new method of exterior indexing by coloring the front edge red, white and blue to indicate the different main sections of the book. First is blue, on which is stamped the words "Trades Index." This is a section of 162 pages in which every product listed in the book is indexed and cross-indexed for ready reference. The red section is the main classified trades list. It contains 1,813 pages, listing over 18,000 different products. In the present edition there are more than 1,200 new headings, including many covering the chemical industry. The third section, as indicated by the white edges, contains 216 pages listing the trade names under which products are manufactured, with the names and addresses of the manufacturers. The second blue section is the alphabetical section of 487 pages containing all the names in the book in one alphabetical list, with addresses and their main line of business. This is followed by a 20-page index to advertisers, containing a full list of branch and foreign offices following each name. The volume contains 2,703 pages.

Obituary

Cyrus Thurston Johnston, mechanical and electrical engineer, died at his home in St. Paul, Minn., Wednesday, Feb. 25, after a brief illness. He was a graduate of the Massachusetts Institute of Technology, class of 1909, and had been associated with his father, Clarence H. Johnston, architect, of St. Paul. At the time of his death he had entire charge of the heating, plumbing and ventilating work of the office. A host of friends will lament the untimely ending of his promising career.

John A. Randolf, of the Westinghouse Electric and Manufacturing Co., died at the Columbia Hospital, Wilkinsburg, Penn., on Friday, Jan. 30, 1920. Death was caused by pneumonia. Mr. Randolf was a graduate of Syracuse University with the class of 1903. Following his graduation he engaged in engineering and writing technical literature for trade magazines; old readers of *Power* will no doubt recall some of his articles dealing with electrical subjects. He was also an active worker for a time with the Society for Electrical Development, located in New York.

Personals

David J. Armour, formerly associated with the United States Rubber Co., has joined the New York City sales force of the McLeod & Henry Co.

Miles B. Lambert was appointed manager of the railway department of the Westinghouse Electric and Manufacturing Co. He has been connected with the Westinghouse forces since 1901.

W. S. Rugg, manager of the railway and marine departments, and Charles Robbins, assistant sales manager, of the Westinghouse Electric and Manufacturing Co., have been appointed assistants to the vice president.

George M. Ogle, formerly chief electrical engineer of the United States Shipping Board, Emergency Fleet Corporation, is now a member of the Engineering Organization of the Vulcan Iron Works, Inc., Jersey City, N. J., in charge of electrical contracting and the consulting engineering department.

A. T. Shurick, of the business staff of the *Coal Trade Journal* has been elected vice president of F. C. Thornley & Co., Inc., at 31 West 43rd St., New York City. Mr. Shurick is a graduate of the Virginia Polytechnic Institute. He was actively engaged in his profession as engineer, for ten years with the Rock Island Coal Co., the Mexican Coal & Coke Co. and the Anaconda Copper Mining Co. In 1911 he joined the editorial staff of *Coal Age*.

Fred W. Herbert has been appointed superintendent of the service department of the National Electric Light Association Headquarters, 29 West 39th St., and George F. Oxley has been selected as director of the publicity department. Mr. Herbert will take charge of interpreting the uniform classification of accounts and rate research and general statistical service for member companies of the association. Mr. Oxley will have charge of the National Association Magazine and all publicity in the interests of the electrical industry..

James T. Hutchings has resigned as president of the Rochester Gas and Electric Corp. to accept the position of assistant general manager with the United Gas Improvement Co., of Philadelphia. Mr. Hutchings is a graduate of the Amherst Agriculture College. He was connected at various times with the Thomson-Houston Electric Co.; the Germantown Electric Co., of Philadelphia as assistant superintendent; the West End Electric Co., of Philadelphia, as superintendent, and with the Rochester Railway and Light Co., of which he became president.

Engineering Affairs

Buffalo Chapter American Association of Engineers, 400 members, has voted to join the Buffalo Chamber of Commerce.

The Pennsylvania Congress for 1920 will be held at Harrisburg March 21-25 under the auspices of the Department of Labor and Industry of the Commonwealth of Pennsylvania. With the exception of Sunday sessions all meetings will be held in the Hall of the House of Representatives.

The American Institute of Electrical Engineers, at the meeting of its board of directors held Feb. 18, decided, in accordance with the recommendation of Vice President Fisken and the Portland section, to hold the 1920 Pacific Coast convention at Portland, Ore., July 21-23.

The Eastern Pennsylvania Chapter of the American Society of Heating and Ventilating Engineers will hold a meeting at the Engineers Club of Philadelphia, 1317 Spruce St., Thursday evening, April 8. An illustrated lecture on "Economizers" will be given by M. C. Sherman, mechanical engineer, of the Green Fuel Economizer Company.

The American Institute of Electrical Engineers, in accordance with the action of its board of directors at a meeting held Feb. 18, and negotiations carried on since, has decided to hold its annual convention at The Greenbrier, White Sulphur Springs, W. Va., June 29-July 2. This is a week later than it was originally planned to hold the convention. Details will be announced later.

The Association of Iron & Steel Electrical Engineers, Philadelphia Section, will hold the following meetings: On April 3, James E. Wilson, electrical engineer of the Treadwell Engineering Co., will present a paper on "Electric versus Gas Welding." On May 1, every active member is invited to prepare a paper on the subject pertaining to the application of electricity to the iron and steel industry.

Business Items

The Dayton-Dowd Co., of Quincy, Ill., has opened a branch office in Cleveland, Ohio, under the management of L. E. Maker, of the Maker Engineering Co., of Chicago.

The Jeffrey Manufacturing Co., of Columbus, Ohio, has opened a new branch office in Los Angeles, Cal. The office will be in charge of F. R. Field, formerly manager of the Denver office.

The Black & Decker Manufacturing Co. has been sold to the Dieffenbach Westendorf Manufacturing Co. The new company is composed entirely of former employees of the Black & Decker Manufacturing Co.

The Hays Engineering Co., of Columbus, Ohio, has a district office at 1008 Scofield Building, Cleveland. The district office manager is Henry Kelsey. The company handles the Joseph W. Hays Corp. line of combustion apparatus.

The Buffalo Forge Company, Buffalo, N. Y., at a recent stockholders' meeting appointed the following new officers: Henry W. Wendt, president; Edgar F. Wendt, Jr., vice president and secretary, and C. A. Booth, vice president and sales manager. The new directors include the above-named officers and, in addition, H. S. Whiting.

Trade Catalogs

G-R Instantaneous Heater. Bulletin No. 231. The Griscom-Russell Co., New York City. 11 pages, 6 x 9 in. illustrating and describing the construction and uses of this heater.

The Sterling Engine Co., Buffalo, N. Y., has recently published a 23-page, illustrated catalog on Sterling engines of the commercial type for boats, pump and generator drives. A page is devoted to gasoline motors for stationary work for driving centrifugal pumps and electric generators; several pages to various Sterling engine models, specifications and installations, and charts showing the guaranteed fuel and horsepower curves of two models. A copy may be had upon application.

Worthington Pump and Machinery Corp., New York City, has issued a new and complete 115-page, illustrated catalog on "Worthington Condensing Apparatus." All types of condensers are described—vacuum and circulating pumps, steam ejectors, relief valves, flow of water in pipes, etc. It has also several pages of low pressure steam tables, a page of conversion tables, with other notes and information.

THE COAL MARKET

BOSTON—Current prices per gross ton f.o.b. New York loading ports:

Anthracite

	Company Coal
Egg	$8.20@$8.65
Stove	8.45@ 9.05
Chestnut	8.55@ 9.05
Pea	7.05@ 7.40
Buckwheat	3.60@ 3.80
Rice	2.30@ 2.50
Barley	1.25

Bituminous

	Clearfields	Cambrias and Somersets
F.o.b. mines, net tons	$2.85@$3.35	$3.15@$3.60
F.o.b. Philadelphia, gross tons	5.05@ 5.60	5.35@ 5.90
F.o.b. New York, gross tons	5.40@ 5.95	5.75@ 6.25
Alongside Boston (water coal), gross tons	7.00@ 7.75	7.60@ 8.00

Pocahontas and New River are practically off the market for coastwise shipment, but are quoted at $6.25@$7.00.

NEW YORK—Current quotations, White Ash, per gross tons, f.o.b. Tidewater, at the lower ports are as follows:

Anthracite

	Company Coal
Broken	$7.80@$8.25
Egg	8.20@ 8.65
Stove	8.45@ 9.05
Chestnut	8.55@ 9.05
Pea	7.05@ 7.40
Buckwheat	5.15
Rice	4.50
Barley	4.85
Boiler	4.85

Bituminous

Government prices at mines:	Spot
South Fork (best)	$3.25@$3.50
Cambria (best)	3.00@ 3.25
Cambria (ordinary)	2.60@ 2.90
Clearfield (best)	3.00@ 3.25
Clearfield (ordinary)	2.60@ 2.90
Reynoldsville	2.85@ 2.90
Quemahoning	3.25@ 3.50
Somerset (medium)	3.00@ 3.25
Somerset (poor)	2.50@ 2.75
Western Maryland	2.50@ 2.75
Fairmont	2.25@ 2.50
Latrobe	2.60@ 2.90
Greensburg	2.75@ 3.00
Westmoreland ¾ in.	3.40@ 3.50
Westmoreland run-of-mine	2.75@ 3.00

PHILADELPHIA—Bituminous coal prices vary according to district from which they are mined. For ordinary slack the price is $2.45@$2.55; lump, $3.35, at the mines.

BUFFALO—

Anthracite

	On Cars, Gross Ton	At Curb, Net Ton
Grate	$8.55	$10.80
Egg	8.80	10.65
Stove	9.00	10.85
Chestnut	9.10	10.85
Pea	7.75	9.30
Buckwheat	5.70	7.75

Bituminous

Allegheny Valley	$4.80
Pittsburgh	4.65
No. 8 Lump	4.65
Mine-run	4.80
Slack	4.10
Smokeless	4.60
Pennsylvania Smithing	5.70

CLEVELAND—Prices of coal per net ton delivered in Cleveland are:

Anthracite

Egg	$12.25@$12.40
Chestnut	12.50@ 12.70
Grate	12.25@ 12.40
Stove	12.40@ 12.60

Pocahontas

Nine-run	$7.50

Domestic Bituminous

West Virginia split	$8.50
No. 8 Pittsburgh	$6.60@ 6.90
Massillon lump	8.25@ 8.50
Coshocton lump	7.15

Steam Coal

No. 6 slack	$5.25@$5.50
No. 8 slack	5.10@ 5.50
Youghiogheny slack	5.25@ 5.50
No. 8 ¾ in.	5.70@ 6.60
No. 6 mine-run	5.25@ 5.50
No. 8 mine-run	5.75

Only coal available is mine-run Pocahontas.

MIDDLE WEST—Chicago quotations, f. o. b. cars at mine:

	Springfield, Carterville, Williamson, Franklin, Saline, Harrisburg	Fulton, Peoria	Grundy, La Salle, Bureau, Will
Lump	$2.55@$2.70	$2.95@$3.10	$3.25@$3.40
Washed	2.75@ 2.90	.....	3.45@ 3.60
Mine-run	2.35@ 2.50	2.75@ 2.90	3.00@ 3.15
Screen'gs	2.05@ 2.20	2.35@ 2.50	2.75@ 2.90

New Construction

PROPOSED WORK

Conn., Bridgeport—C. J. Lewis, 166 Fairfield Ave., will receive bids for the construction of a 3 story, 67 x 87 ft. bowling alley addition and altering of present building on Elm St. A steam heating system will be installed in same. Total estimated cost, $100,000. Davis & Done, 1024 Main St., Archts. and Engrs.

Conn., Torrington—J. A. Jackson, Archt., 1133 B'way, New York City, will soon award the contract for the construction of a 1 story, 125 x 130 ft. church on Union St., for the St. Marys Polish Roman Catholic Society, Rev. J. Kowalski, Pastor. A steam heating system will be installed in same. Total estimated cost, $125,000.

N. Y., Arcade—The Bd. Educ. is having plans prepared for the construction of a school building. A steam heating system will be installed in same. Total estimated cost, $125,000. Tooker & Marsh, 101 Park Ave., New York City, Archts. and Engrs.

N. Y., Little Falls—The Bd. Educ. is having plans prepared for the construction of a school building. A steam heating system will be installed in same. Total estimated cost, $125,000. Tooker & Marsh, 101 Park Ave., New York City, Archts. and Engrs.

N. Y., New York—The Bd. Educ., 500 Park Ave., is having plans prepared for the construction of a 5 story, 70 x 145 x 145 ft. school on 87th St. A steam heating system will be installed in same. Total estimated cost, $470,000. C. B. J. Snyder, Municipal Bldg., Archt. and Engr.

N. Y., New York—The Merchants & Shippers Insurance Co., 49 Wall St., is having plans prepared for the construction of a 12 story office building at 14 South William St. A steam heating system will be installed in same. Charles H. Higgins, 19 West 44th St., Archt. and Engr.

N. Y., New York—The Post Office Dept., U. S. Government, Wash., D. C., is having plans prepared for the construction of a 4 story, 125 x 200 ft. post office building, here. A steam heating system will be installed in same. Total estimated cost, $400,000. John H. Sheier, 25 West 42nd St., Archt. and Consult. Engr.

N. Y., Ogdensburg—Williams & Johnston, Archts., will receive bids for the construction of a 1 story, 73 x 289 ft. factory building, a 70 x 130 ft. foundry and a 25 x 45 ft. garage on Green St. Power boilers and a complete steam heating system will be installed in same. Total estimated cost, $100,000.

N. Y., Ossining — Charles F. Rattigan, Supt. of the State Prisons, Hall of Records Bldg., Capitol, Albany, will receive bids until March 23 for the construction of a pump house and installation of heating systems, etc., at the Sing Sing Prison, here.

N. Y., Randalls Island—The Dept. of Pub. Charities, Municipal Bldg., New York City, received bids for delivering and installing 4 new boilers in the power house, here, from Chute, Thornton & Bailey, 2 East 13th St., New York City, $55,800; Boston Eng. Co., 308 Atlantic St., Boston Mass., $69,875; W. J. Olvany, 177 Christopher St., New York City, $74,380.

N. Y., Schenectady—Dubois B. Bennett & Son, Contractors, Engrs., and Builders, 413 McClellan St., are in the market for second hand equipment including one 18 or 20 C. F. Mixer, Hopper Loading with engine, with or without boiler, 1 hoisting engine D. D. d. c. skeleton, 1 stiff-leg derrick 80 ft. boom 10 ton capacity, fittings to be for 3 lines, 1 C. Y. clamshell bucket, independent swinging engine, 1 40 to 60 hp. locomotive type boiler and 3 line derrick fittings.

N. Y., Seneca Falls — The Seneca Co. Products Creamery Co. Inc., will install an ammonia cold storage plant and ice cream making machinery. Total estimated cost, $5,000. Address William L. Clark.

N. J., Vineland—The Catholic Church of the Sacred Heart will soon award the contract for the construction of a 2 story, 60 x 120 ft. school. A steam heating system will be installed in same. Total estimated cost, $100,000. Berry & Cummiskey, Real Estate Trust Bldg., Philadelphia, Archts.

Pa., Boiling Springs—The Boiling Springs Electric Light & Water Co. plans to install one 100 kva., 2,400 volt, 3 hp., 60 cycle, 1,200 r.p.m. Westinghouse a.c. generator for the lighting system. J. C. Bucher, Mgr.

Pa., Dushore—The Sullivan Co. Electric Co. plans to install a new generator and boiler and construct a 3 mi. transmission line. H. L. Troxell, Mgr.

Pa., Ford City—The Municipal Electric Light Plant plans to install one more unit. P. J. Wintgens, Supt.

Pa., Grove City—The Municipal Electric Plant plans to install one 125 kw. unit directly connected to oil engine and construct 3 mi., 3 ph., 3 wire, 2,200 volt transmission line. Frank H. Poehlman, Supt.

Pa., Hazleton—The Hazleton School Bd. plans to build a 2 story, 100 x 100 ft. junior high school at Hazleton Heights. A steam heating system will be installed in same. Total estimated cost, $200,000.

Pa., Larksville—(Wilkes-Barre P. O.)—St. John's Church Congregation plans to build a 3 story, 50 x 100 ft. school building. A steam heating system will be installed in same. Total estimated cost, $100,000.

Pa., Monessen—The Borough of Monessen will soon receive bids for the construction of a deep well pump. Chester & Fleming, Union Bank Bldg., Pittsburgh, Engrs.

Pa., Orrtanna — The Orrtanna Electric Light & Power Co. plans to construct a transmission line from here to Biglerville. S. Z. Musselman, Mgr.

Pa., Oxford — The Oxford Electric Co. plans to construct an extension to transmission system. Estimated cost $100,000. J. H. Ware, Mgr.

Pa., Philadelphia—Proctor & Schwartz, Tabor Rd. and 6th St., will build a 4 story, 77 x 150 ft. factory addition. A steam heating system will be installed in same. Total estimated cost, $150,000. Day & Zimmerman, 611 Chestnut St., Archts. and Engrs.

Pa., Pitcairn — The Municipal Electric Light & Power Plant plans to install a new 200 kva. gas unit. M. H. Stout, Secy.

Pa., Ridgway—The Ridgway Electric Light Co. plans to install one 5,000 kva. turbo-generator, boiler and condenser equipment and construct about 2 mi., 22,000 volt transmission line. W. H. Brown, Supt.

Pa., Scranton — Worthington Scranton, Monroe and Linden Sts., will soon award the contract for the construction of a 1 story, 85 x 195 ft. school on Clay Ave. and Poplar St. A steam heating and ventilating system will be installed in same. Total estimated cost, $100,000. Edward H. Davis and William G. D. Lewis, Union Bank Bldg., Archts.

Pa., Williamstown — The Lykens Valley Light & Power Co. plans to construct a 5 mi., 3 ph. transmission line. J. B. Whitworth, Mgr.

Md., Baltimore—The Hess Steel Corp., Biddle St. and Loney's Lane, is in the market for a 75 ft. stack, measuring 10 in. in diameter.

Md., Baltimore — Samual T. Williams, 223 North Calvert St., is in the market for a 100 hp. steam engine, either throttling or automatic (used).

N. C., Wake Forest—The Mayor will receive bids until March 25th for the construction of a pumping station, tower tank, etc. W. M. Piott, Durham, Engr.

S. C., Bamburg—The Comrs. of Pub. Wks. plan to install one 125 kw. generator. J. F. Black, Supt.

S. C., Chesterfield—The Teal Light & Power Co. plans to install a duplicate unit. D. T. Teal, Mgr.

O., Cleveland—The city will soon award the contract for installing two 125 hp. boilers with stokers. Total estimated cost, $10,000. C. C. Smith, Engr.

O., Cleveland—The city received bids for the installation of two 850 gal. per min. centrifugal feed water pumps, from Dravo-Doyle Co., Citizens Bldg., $9,850 and $10,598; J. Sheldon Engine Co., Toledo, $10,820 and $11,024.

O., Cleveland—St. Joseph's Church, Rev. J. W. Bell, Pastor, 14422 Aspinwall Ave., is having plans prepared for the construction of a 3 story, 80 x 145 ft. school on St. Clair Ave. between East 144th and 146th Sts. A steam heating system will be installed in same. Total estimated cost, $300,000. Charles Greco, Guardian Bldg., Archt.

O., Cleveland—St. Stanislaw's Church, Rev. W. Krzyceki, Pastor, 3649 East 65th St., plans to build a 3 story school building. An extension to steam heating system in present plant will be installed in same. Total estimated cost, $150,000. W. C. Jansen, Electric Bldg., Archt.

O., Cleveland—M. Silverberg, 9305 Hough Ave., is having preliminary plans prepared for the construction of a 2 story theatre and commercial building on East 152nd St. and St. Clair Ave. A steam heating system will be installed in same. Total estimated cost, $100,000. F. J. Prochaska, 11111 Buckeye Rd., Archt.

O., Cleveland—W. Taylor Son & Co., 630 Euclid Ave., plans to construct a 130 x 150 ft. warehouse on East 17th and Superior Ave. A steam heating system will be installed in same. Total estimated cost, $100,000.

O., Columbus—R. L. Wirtz, 2080 Luka Ave., is having plans prepared for the construction of a 4 story, 62½ x 131½ ft. office building on East State St. A steam heating system will be installed in same. Total estimated cost, $250,000. E. E. Pruitt, 209 South High St., Archt.

O., Jewett—The village will receive bids until March 25 for the construction of a municipal waterworks plant including deep well pumps, steel reservoir, etc. George H. Collins, Pres. of the Bd. of Trustees of Public Affiairs.

O., Marion—The Bd. Educ. will receive bids until March 29 for the construction of a 2 story, 70 x 90 ft. school on Grand Ave. A steam heating system will be installed in same. Total estimated cost, $100,000. H. J. Merchant, Clk. O. D. Howard, 8 East Broad St., Columbus, Archt.

Ia., Ames—The Dept. of Eng., will soon receive bids for the construction of a sewage disposal plant consisting of a pumping plant, etc., for the city. Total estimated cost, $100,000. P. E. Hopkins, Mgr.

Ia., Aurelia—E. S. Kiernan, Secy. of the Bd. Educ. received bids for the installation of a heating and plumbing system in the proposed 3 story, 75 x 166 ft. school building from the C. F. Rock Plumbing & Heating Co., St. Joseph, Mo., at $41,895.

Ia., Des Moines — Frank Jeffries, City Clk., will soon award the contract for the installation of 1 single unit electric sump pump in connection with the Northeast Sanitary Sewer system project. Total estimated cost, $35,000. K. C. Kastberg, City Engr.

Ia., Sutherland—F. E. Tellier, Pres. of the Bd. Educ. is having plans prepared for the construction of a 3 story, 60 x 140 ft. consolidated school building. A steam heating and ventilating system will be installed in same. Total estimated cost, $125,000. Keffer & Jones, 204 Masonic Temple, Des Moines, Archts.

Minn., Nashwauk—R. M. Blockburn, Clk., will receive bids until March 20 for the construction of a 3 story, 160 x 174 ft. high school for the School Dist. 9, Itasca Co. A steam heating and ventilating system will be installed in same. Total estimated cost, $400,000. W. T. Bray, Torrey Bldg., Duluth, Archt. and Engr.

Kan., Ft. Scott—Thogmartin & Gardner, Contractors, are in the market for one 75 hp. traction engine.

Neb., Kearney—The State Bd. Educ. will receive bids until April 11 for the construction of a 3 story, 64 x 160 ft. dormitory. A steam heating system will be installed in same. Total estimated cost, $100,000. J. H. Craddock & Co., Elks Bldg., Omaha, Archt.

S. D., Armour—The South Dakota Light & Power Co., plans to install one 500 hp. oil engine Diesel or semi-Diesel type and one 300 hp. producer. G. W. Welch, Supt.

N. D., Fargo—The Public Service Garage Co. will soon receive bids for the construction of a 2 story, 140 x 200 ft. garage. A steam heating system will be installed in same. Total estimated cost, $125,000. Braseth & Rosatti, 105½ B'way, Archts.

Wyo., Riverton — Dubois & Goodrich, Archts., Townsend Bldg., Casper, will receive bids until April 15 for the construction of a 2 story public school for the city. A steam heating and ventilating system will be installed in same. Total estimated cost, $100,000.

Mo., Fulton—Holmes & Flynn, Archts., 8 South Dearborn St., Chicago, will receive bids in March for the construction of a 3 story 65 x 140 ft. academy, for the William Woods College. A steam heating system will be installed in same. Total estimated cost, $125,000.

Mo., St. Louis—The Lehmann Machine Co., 606 South B'way, plans to construct a 2 story, 110 x 195 ft. factory on La Salle and Grand Sts. A steam heating system will be installed in same. Total estimated cost, $450,000.

Mo., St. Louis—The Wiedmer Eng. Co., Archts., Syndicate Trust Bldg., will soon receive bids for the construction of a 3 story, 180 x 200 ft. factory for the manufacture of automobiles, on Forest Park Ave. and Sarah St., for The Dorris Motors Corp., Sarah St. and Laclede Ave. A steam heating system will be installed in same. Total estimated cost, $350,000.

Tex., Abilene—The Abilene Gas & Electric Co., plans to install a new generating plant of a 25 kw. capacity. J. W. Dawley, Mgr.

Tex., Archer—The Municipal Electric Plant plans to construct an entire new plant for the generating system. A. Minnich, Mgr.

Tex., Bastrop—The Bastrop Water, Light & Ice Co. plans to install one 150 kva. generator. J. E. Haines, Supt.

Tex., Cisco—The Cisco Gas & Electric Co. plans to construct a transmission line from here to Abilene. P. W. Campbell, Mgr.

Tex., Gordon—The Gordon Mingus Light Co. plans to install a 50 hp. unit in the generating system. S. W. Daws, Mgr.

Tex., Henderson—The Henderson Cotton Oil & Gin Co. plans to install a complete new generating plant. O. E. Morris, Mgr.

Tex., Lometa—The Lometa Light & Power Co. plans to install an additional oil engine in the generating system. M. D. Melear, Mgr.

Tex., Marshall—The Marshall Electric Co. plans to install one 1500 kw. turbo generator. W. Campbell, Mgr.

Tex., Nocoma—The Nocoma Ice & Light Co. plans to install a new 75 kw. 250 volt d.c. generator, and construct a 3 wire, 250 volt transmission system. J. W. Lehman, Mgr.

Tex., Palacios—The City of Palacios plans to install one 75 kva. generator. M. Lipscomb, Supt.

Tex., San Benito — The Commonwealth Water & Electric Co. plans to install one complete 200 hp. unit in generating system. A. L. Harris, Mgr.

Tex., Troup—The Troup Power & Light Co. plans to replace the power plant with a transmission line. H. E. DeLawe, Vice Pres.

N. M., Silver City—The Silver City Nati. Bank is having plans prepared for the construction of a 6 story, 102 x 146 ft. hotel. A vacuum steam heating system will be installed in same. J. J. Frauenfelder, 1116 Story Bldg., Los Angeles, Archt.

Utah, Myton—The Uintah Power & Light Co. plans to construct a new power plant and a transmission line to connect with 6 small towns. J. H. Colthorp, Mgr.

Ariz., Phoenix—Charles Korrick, c/o L. M. Fitzhugh, Archt., 210 Noll Bldg., is having plans prepared for the construction of a 4 story, 123 x 130 ft. office building on 3rd Ave. and Washington St. A steam heating system will be installed in same. Total estimated cost, $250,000.

Ariz., Phoenix—The Salt River Valley Water Users Association plans an election in April to vote on proposed installation of pumps, etc. Total estimated cost, $400,000. D. W. Murphy, 606 South Hill St., Los Angeles, Cal., Consult. Engr.

Wash., Chelan—The Chelan Electric Co. plans to install a 75 kw., 3 ph. generator and construct a 3 mi. transmission line. F. V. Harper, Mgr.

Wash., Clarkston—The Washington, Idaho Light & Power Co. plans to extend a 9 mi. transmission line from here to Cul de Sac, Idaho. F. J. Keyes, Mgr.

Wash., Connell—The Town Council plans to construct a waterworks system for domestic purposes including the installation of a pumping plant, etc. Total estimated cost, $8,000. C. K. Bell, Clk.

Wash., Ephrata—The Ephrata Light & Power Co. plans to change generating system from a 110 to 250 hp. L. R. Nelsen, Mgr.

Wash., Republic—The Republic Light & Power Co. plans to construct a new pipeline at power house in generating system. A. L. Capper, Mgr.

Wash., Seattle—The Westminster Presbyterian Church, B'way and East Columbia St., has retained R. H. Orr, Archt., 1301 Van Nuys Bldg., Los Angeles, to prepare plans for the construction of a 126 x 140 ft. church. Steam heating and ventilating system will be installed in same. Total estimated cost, $125,000.

Wash., Walla Walla—The city plans to construct a hydro electric plant based on 50 second ft. water to generate 1,000 kw. of power, capable of furnishing 900 kw., 1,200 hp. at city line. Total estimated cost, $381,000. E. B. Hussey, Alaska Bldg., Engr.

Wash., Yacolt—The Northwestern Electric Co., Portland, Ore., is making surveys for an electric power plant site near here. Estimated cost, $5,000,000.

Ore., Portland—The Multnomah Hospital Comn. plans to build a 5 story, 150 x 210 ft. building. The boiler house and laundry departments are to be in a separate building. Total estimated cost, $800,000.

Ore., Stayton—The Stayton Light & Power Co. plans to install a 125 hp. engine. H. J. Rowe, Mgr.

Cal., Burlingame—The City Trustees received bids for furnishing and installing two pumps for the city waterworks system, from the Simonds Mchy. Co., 117 New Montgomery St., San Francisco, $11,107; L. E. Penniman, San Mateo, $12,581.

Cal., Huntington Park (Los Angeles P. O.)—The City Trustees are having plans prepared for the installation of pumps, construction of a 1,000,000 gal. reservoir, etc. The city voted $160,000 bonds for this project. F. E. Trask, 616 Union Oil Bldg., Las Angeles, Engr.

Cal., Redlands—The Redlands University retained N. F. Marsh, Archt., 211 B'way Central Bldg., Los Angeles, to prepare plans for the construction of 3 buildings including a 2 story dormitory and 2 smaller buildings for the Art Dept. An extension to the steam heating system will be installed in same. Total estimated cost, $120,000.

Ont., Ingersoll—W. G. Murray, Archt., Dominion Savings Bldg., London, will soon award the contract for the construction of a 2 story school for the School Bd. A steam heating system will be installed in same. Total estimated cost, $125,000. R. B. Hutt, Chn.

Ont., Kingston—The Paramount Theatres, Ltd., Temple Bldg., Toronto, plan to build a 1 and 2 story theatre. A steam heating system will be installed in same. Total estimated cost, $350,000. N. L. Nathason, Temple Bldg., Toronto, Mgr.

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